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Devoted to the interests of the engineers and technical officials of the cities, counties and states

FEBRUARY, 1938

A. PRESCOTT FOLWELL, Editor — VOL. 69, NO. 2 — W. A. HARDENBERGH, Asso. Editor

Contents

TIMEWASTERS

Preliminary:

As usual, at the Road Show, Timewasters were quite popular. The acre upon acre of concrete floor made considerable impression on many pedal extremities. As one habituate of the show said, "When the soles of my feet get up near my armpits, it's nice to sit down and look at Timewasters, even if I can't do them." Probably the sitting down was best of all.

As for last month, two of the problems were easy and the other one was incorrectly stated. In the boy and apple problem, the boy with the 3 apples got 8 cents, and the one with 2 apples 2 cents. Mikey rode exactly 9 miles; it didn't make any difference how far he walked.

The apple and headache problem should have read: A fruit store proprietor arranged the apples from a box in the form of a square based pyramid, but when his wife complained that this pyramid interfered with her vision out of the window he then rearranged them into two smaller triangular pyramids. The number of apples in the perimeter of the base of the larger triangular pyramid is 3 more than in the smaller, and 12 less than in the square based pyramid. How many apples?

More Apples:

Bob Clark has dug himself out of the snow in upstate New York and sends in this: Ikey and Mikey started operations in the apple market on a partnership basis. Each took out 30 apples every morning. Ikey sold his 2 for 1 cent, while Mikey sold his 3 for 1 cent. At the end of the day they pooled their gross income of 25 cents. One day Ikey was unable to attend to his business affairs, so Mikey took over the combined sales and, after a bit of close reasoning offered his apples for sale at 5 for 2 cents, which he figured to be equivalent to the old basis. At the end of the day he found he had only 24 cents, so his faulty reasoning cost him a penny that day. The question is, of course, what was the error Mikey made?

The Water Problem:

A reservoir has plane sloping sides and ends; its top and base are horizontal rectangles of sides 24 ft. and 16 ft., and 12 ft. and 8 ft. respectively, and its depth 40 feet. If water flows into it at the uniform rate of 30 cubic feet per minute, at what rate is the surface rising when the depth of the water it 10 ft.? Contributed by John Bevan. W. A. H.

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91 helpful booklets and catalogs are described on pages 59-62. Look them over.

PUBLIC WORKS
City, County and State Engineering and Construction

FEBRUARY, 1938
Vol. 69, No. 2

Five Years' Operation of the Wichita Sewage Disposal Plant

By P. L. BROCKWAY
City Engineer, Wichita, Kans.

THE sewage disposal plant of the City of Wichita, Kansas, was designed in 1931 by Black & Veatch, consulting engineers, using data compiled jointly with the City Engineering Department, and construction was supervised by that department with the consultants in an advisory capacity. Some of the statements in this discussion might be construed as critical of the design, but they are not so intended. The plans were very complete and elements of design were well considered, but financial limitations made it necessary to eliminate all but the most essential metering devices.

The plant is for preliminary treatment only, with separate sludge digestion, to handle an average flow of 13 mgd, including 2.5 mgd of industrial wastes. In functional order, the sewage passes first through mechanically cleaned bar screens, screenings from which are conveyed by belts to an incinerator using sludge gas as fuel. The sewage then is raised from the receiving well about 28 feet by float-controlled, electrically driven pumps, and flows by gravity through the plant. A grit chamber with Link-Belt drags is next in line. From there the sewage passes through a pre-aeration tank, thence to rectangular settling tanks with Link-Belt drags, which skim the grease on their return. Raw sludge is pumped into closed digestion tanks with fixed concrete covers built with pre-stressed steel under Hewitt patents.

Gas is collected in all three tanks, some passing to storage in a water seal gas holder, other wasted to air. Hot water circulation is provided for the digestors, sludge gas being used in the boilers.

Digested sludge is drawn onto open drying beds, from which it is removed in cars operating on tracks located between the beds.

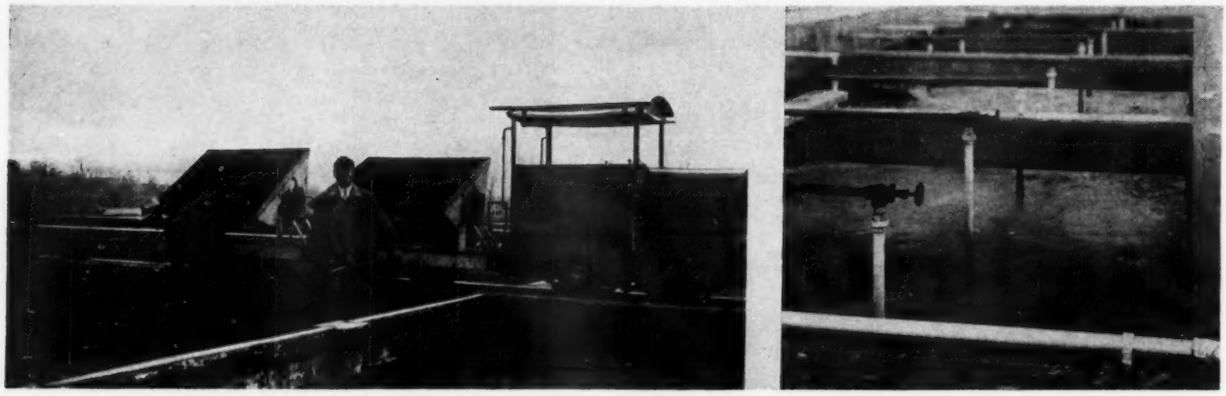
P. L. Brockway, and the gas separator

Replacement, revision and ordinary maintenance of all items have been recorded separately for each unit. This segregation applies to materials and supplies only, practically all of the labor being done by regular operating employees.

The outfall sewers are three to five miles long, grades are very slight (6 to 8 feet per 10,000); sewage temperatures run up to 80° or even higher; average concentration of suspended solids during lower flow seasons is about 420 ppm. A survey of the principal outfalls in May, 1937, indicated an average concentration of 13 ppm of sulphides in the sewage in the principal collecting main near the disposal plant. At other points the concentration was still higher. Most of the sulphides were soluble H_2S. It was calculated at that time that about 900 pounds per day were carried into the plant in solution.

It may be said in passing that one of the outfall sewers, of reinforced concrete, placed in operation in 1919, carries sewage with an H_2S content of 5 to 25 ppm and has been so seriously disintegrated that it must be replaced at an early date.

Bar Screens. The wet well in the pump house is entirely covered, the roof of the well being the floor of a one-story building in which the operating mechanism for cleaning the bar screens and the screenings incinerator is located. There is necessarily an opening in the floor, over the wet well. Turbulence in the screens released such volumes of H_2S that the automatic control timing devices were moved at once entirely away from the screen room. Cadmium turned yellow, copper vanished, springs fell to pieces. (I should be inclined to put the screen room in an entirely separate building to keep gases away from other equipment.) The motors directly over the pit have given little trouble, partly



Left, Removing 3 inches of dried sludge from sludge beds. Right, Connections to porous tubes in preliminary aeration tanks.

because ventilating fans have been set in windows immediately opposite and close to them. (An industrious mud dauber wasp shorted one of them out in 1935.) The original cables operating the rakes corroded out in ten months. They were of special flexibility with fine wires and in 1935 were replaced with ordinary 3/8" plow steele cable having heavier wires. They are oiled daily and have not suffered any visible depreciation.

Total cost of material and parts has been $244.58 in nearly five years on two Link-Belt automatic mechanically cleaned screens under these conditions.

Screenings Conveyor Equipment consists of two motor-driven belts, one horizontal and one inclined, discharging into a drying oven over a gas-fired incinerator. Belts are acid resisting. They should be grease proof. One belt has been replaced, using the old one for repairs. Total expense, $89.40.

The Incinerator is a two-story, drying oven above, discharging at the rear of the fire box through a stoking hole. It is fired almost continuously, using 500 cubic feet of gas per hour, as gas would otherwise be wasted and continuous firing prevents excessive contraction and expansion. Total maintenance is $30.10 for fire clay and a new casting over the stoking hole.

Sluice Gates in Wet Well. Four sluice gates in the entrances to the wet well are motor operated with push button control. Although these controls are in a bad location for gas, the springs and contacts have been replaced only once, at a cost of $41.36.

Wet Well. The receiving well is reinforced concrete, 28 feet deep, with the discharge flume at the upper level under the floor. It was protected with an asphaltic paint and with mopped burlap. The paint was inert but not 100% gas tight, and sulphation has reached a depth of about two inches in five years, being apparently most severe in the winter when the walls in contact with the earth are cooled and moisture condenses on them. They will be sanded and built up with gunite this winter at a cost of about $5,000. Aluminum base cement will be used in the thinner structural members to check corrosion, it having a higher resistance to H_2S than plain cement.

Switchboard Equipment. Very little trouble has developed in the complex automatic control of the raw sewage pumps, which are operated with synchronous motors starting many times daily under developing load. $100.73 has been spent in five years to replace corroded springs and braided flexible connections. Brass and copper does not stand up very long. Silver blackens but corrodes very slowly. Nickel plate is apparently quite effective. Aluminum paint on braided connections prolongs their life. Aluminum wire shows no evidence of corrosion in five years.

Air Compressors. There are two rotary-type compressors with 15 hp motors. One at a time is operated continuously. Bearings of one were overhauled after two years' operation but they have not yet shown any signs of further distress after nearly three years' further operation. The original magnetic starting switches were entirely too light and flimsy and have been replaced with better equipment. Total cost, $153.31.

Raw Sewage Pumps. There are three identical units of horizontal centrifugal pumps directly connected to synchronous motors, rated capacity 10 mgd at 360 rpm against 28 ft. head. Acceptance tests showed them well within manufacturer's guarantee. Each pump operates an average of about 8 to 10 hours per day.

Shaft packing sleeves are water lubricated from external clear water supply. At the end of two years, the bronze sleeves and bearings were replaced in all three pumps; and in a little more than one more year, they were replaced again. Stainless steel sleeves and wearing rings were placed on two of them in the fall of 1936 and have given no further trouble, but the third, which was replaced with bronze at the same time, stayed less than a year and has been replaced with stainless steel. The sewage carries considerable grit which can work in against the flowing stream of clear water, and the high H_2S content of the sewage is especially active on all copper metals. (I should specify stainless steel for such service; examination of those in use for more than a year showed negligible depreciation.) Total cost has been $1,479.36.

Water Supply Pump. The disposal plant is in an isolated location, and the necessary water supply is derived from ground water and elevated into a tank against a total head of about 100 feet by a multistage vertical centrifugal pump, running about one-third of the time. After four years' operation, it became necessary to renew the working parts of the pump. Cost $351.98, including some replacement of electric control details.

Sludge Pumps. Three raw sludge pumps of the diaphragm plunger type with rubber-faced ball valves as originally installed never worked satisfactorily. They operated too fast for the type of sludge, so that a pressure gauge on the suction side showed a decided negative pressure even though there was several feet head on the line, which caused the pumps to run with excessive vibration and fluctuation in load, and the sheaves were changed to a different speed ratio on the V belt drives. The most serious trouble came from pig toe nails from packing plant waste which came down with the sludge, the sharp points of which caused so much interruption of operation by sticking into the ball valves and holding them open that a full time

attendant could not keep them operating. These pumps were replaced with high-speed screw-feed centrifugal pumps, which grind up such foreign matter, and have given no trouble in over two years. After 7,100 hours' service the screw in one of them was refaced, and the bearings have been renewed after 7,000 hours' service. (Manufacturer's guarantee on this bearing service is 4,000 hours.) Total maintenance on the screw pumps is $131.66.

Digestor Boilers. The expense of installing bypass water connections and recording and indicating thermometers (to be explained later) is about $300. Including this item, total maintenance is $619.87. The boilers now need new housing at the end of five years. (The cost of this will be $105 per boiler.)

Aeration Tank. This is a relatively small tank for preliminary aeration. Intermittent operation of the fixed-speed sewage pumps permitted much sedimentation and the aeration plates, set in V-shaped grooves in the bottom, clogged badly, resulting in blowing of the seal around the plates. The uneven struggle to maintain them was abandoned in 1935 and they were replaced with tubes mounted on the lower end of vertical pipes which are connected to the upper manifold with unions and can be easily lifted out, one unit at a time, for cleaning. A reserve supply of tubes makes it possible to exchange tubes which have been cleaned and put the unit back into service at once. Cost of the installation was $1,025.26.

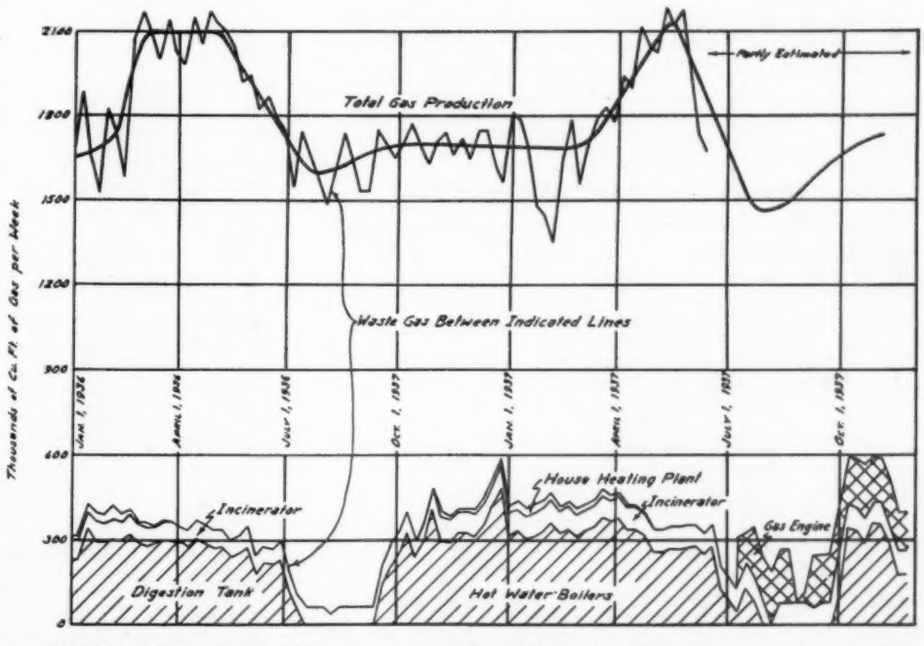
Settling Tanks are in two units, rectangular in type, with sludge collectors and grease skimmers. The dissolved H_2S seems to be very active in its effect on the chains; corrosion and embrittlement are both fairly apparent and the ordinary expected life of the chains is about cut in two. The first failures came at the end of about two years of service. Some of the original chains are still in use at the end of nearly five years, but replacements are rather general. We are trying out another metal in parallel with the original to determine if there is any difference. Maintenance has been $3,086.09.

Buildings. The original copper roofs were attacked by the H_2S quite severely and in spite of painting the upper surface they developed serious leaks in four years and were renewed with old style 40-pound tin, which was painted with aluminum. It will remain to be seen how this metal stands up. Titanium oxide base paint has stood up well on the trim, being renewed the fifth year. Aluminum paint on metal sash and railing stands up with only normal wear and depreciation.

Building maintenance includes new roofs, $750; paint (not including labor), $250; hot water house heating system, $20. The buildings have practically no depreciation, being of brick walls, steel sash, metal doors and frames, tile roofs except for the renewed flat decks.

Sludge Beds cover about two and one-half acres. They are of the usual sand on stone and tile underdrained type. They are located on very light sandy soil, approaching clean, fine sand, and no water from freshly drawn sludge has ever reached the outlet of the drainage system. Removal of sludge is by hand into dump cars, which are hauled to a trestle with a dinky gasoline power locomotive. So much sludge is produced that it would require almost full time of two men to remove it and keep the sand built up in the beds. Much removal has been done by relief forces hauling the fertilizer to the city park system. When it piled up too much at the trestle, we experimented with drawing the sludge off into a lagoon naturally formed by an abandoned creek bed near one corner of the drying beds. Sludge was drawn into it as much as ten feet deep without any adverse results. These deep deposits dry slowly but have been cleaned out to the bottom twice in work relief projects. We are, therefore, developing about fifteen acres of lagoons near the plant which can be filled to a depth of seven feet by installing a small booster pump. They will be cut into units which can be filled in rotation or left permanently filled if the supply continues to outrun the ordinary demand. Subsoil is a fine, light, fluffy sand underlaid with sand having a grading factor of about 2.25 and extending well below the adjacent river bed elevation. The sludge beds will then be operated only as fast as sludge may be removed by persons coming for it at such times as the lagoons are not in condition to handle. It is indeed possible that the crushed rock may be removed from some of the drying beds and used to develop roads around the lagoons, and the open-joint sewer tile be salvaged and the drying beds themselves converted into shallow lagoons.

Gas production and utilization at this plant will be discussed at length in the next issue. The gas was formed in greater volume than had been expected, and very interesting data concerning this, the effect of heat, of intermittent sludge pumping and other features will be described, and illustrated by several charts, one of which is shown below. Some practical conclusions from experiences with the pumping plant will be found to be of special interest.



This chart shows gas production and use at the Wichita plant. With four other charts, it will appear in the March issue.

Mixing with a motor grader. The windrow must be turned enough to give a thorough mix.

Using Tar fo

A STABLE soil is one that will support the loads coming upon it without serious distortion of the soil. When considered in connection with natural soils, stability is a relative term. Most soils are stable at some particular moisture content. Clays, for example, are stable when dry and very unstable when wet. Sands, on the other hand, are stable when wet and unstable when dry. Most soil stabilization, until very recently, has been based on these factors. The clay and the sand or gravel content of the soil has been balanced to produce a stable mixture. Some chemical has then been added in an attempt to keep the moisture content fairly constant.

Tar soil stabilization approaches the problem from another angle. The tar modifies the colloidal properties of the clay and also makes the clay resistant to water. For a soil with a very high clay content, a large amount of tar may be required because of the large surface area of the fine clay particles which must be coated with tar. It is often more economical to add sand to the soil and thus reduce the clay content and the amount of tar needed. However, a definite grading, such as required for chemical soil stabilization, is not necessary for tar soil stabilization. On the other hand, a soil may consist almost entirely of sand, and here again a comparatively large amount of tar may be needed for stabilization because the tar must act both as a binder and as a waterproofing agent. The addition of clay to the sand may lower the cost of the work by reducing the amount of tar required. Admixtures of clay or sand are not necessary for tar soil stabilization in general, but they may reduce the cost on specific projects.

Steps in Design and Construction

The various steps in soil stabilization with tar may be stated as follows:

Preliminary

Determination of amount of tar
Determination of grade of tar
Determination of optimum moisture content
Determination of admixtures of sand or clay

Construction

Breaking and pulverizing
Adding clay or sand
Securing proper moisture content
Prime coat on base
Applying tar to soil
Mixing—Road or Plant
Consolidating
Tack coat on top of stabilized layer
Traffic-resisting top

*Consulting Engineer, General Tarvia Department, The Barrett Company.

The determination of the correct amount of tar to be used for the stabilization of a particular soil is a laboratory project at present. Samples of soil are taken from the road and the material passing a No. 10 sieve mixed with various percentages of tar in the laboratory. These mixtures are then investigated for water absorption and resistance to distortion under load. The mixture showing the best results is selected for the soil mortar. Knowing the amount of aggregate above the No. 10 sieve in the road, it is easy to calculate the gallons of tar necessary for a square yard per inch of depth. The laboratory procedure is somewhat complicated and requires considerable time to reach an answer. It is expected that the procedure will be simplified and portable apparatus devised so that the work can be done at the roadside.

An ordinary soil which does not contain either an excess of clay or an excess of sand can usually be stabilized by the use of approximately one-half gallon of tar per square yard per inch of consolidated depth.

The grade of tar is selected at the same time the amount is determined. There is considerable leeway in the selection of the tar grade. In general, a light tar will be used for a clay soil and heavier tars used as the amount of sand is increased. The heaviest tar which can be mixed with the particular type of soil should be used.

Any individual soil rolled or tamped in a particular manner will consolidate to the maximum density when it contains one certain definite amount of moisture. This will usually run about ten per cent, although it may vary either side of that figure. This optimum moisture content is determined on the soil sample in the laboratory. Damp soils will mix more readily with tars than dry soils, and the optimum moisture content will produce about the correct degree of dampness for efficient mixing.

If sand or clay is available near the project, it should be sampled at the same time the soil in the road is sampled. A laboratory determination will show just how much tar can be saved by the addition of sand or clay to the original road soil. Soils containing more than seventy-five per cent of either clay or sand will generally require more than the minimum amount of tar, and the use of sand or clay admixtures, as the case may be, should be investigated.

Construction Procedure

The soil in the road should be broken or scarified to the proper depth for the specified thickness of foundation. The soil should then be pulverized to break the lumps so that there will be no pieces larger than about

GEO. E. MARTIN*

ar for Soil Stabilization

a half inch in size. A disc harrow assisted by a blade grader is generally used for this purpose. For small areas, one of the agricultural tilling machines may be used. There is a field for a more efficient pulverizing machine.

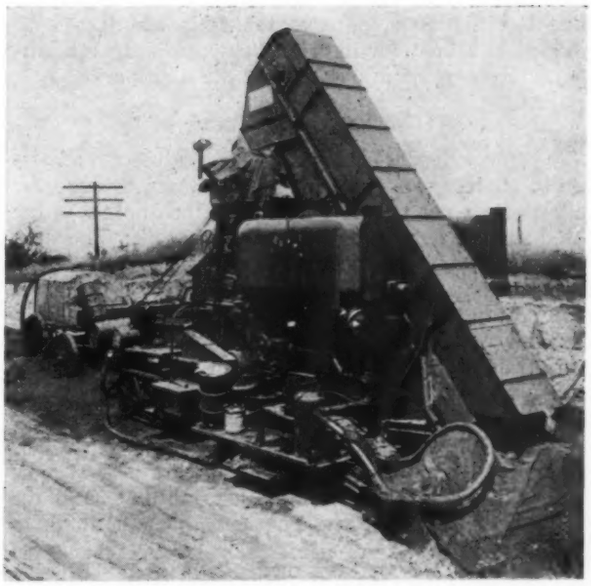
If clay or sand is to be added to the soil, it should be added during the pulverizing operations and thus be mixed properly with the soil.

If the artificial addition of water in order to produce a damp soil is necessary, it should be added at this time. Sufficient water to produce a wet or sloppy mix is neither necessary nor desirable. However, if this occurs because of rain, the tar may be mixed with the wet soil in a satisfactory manner, but the mixture must be allowed to dry before consolidation.

A layer of tar should be provided on the top of the sub-base underneath the stabilized soil to stop water from coming up through the stabilized layer. To accomplish this, the loose material in the road should be moved into one or more windrows to expose the top of the subgrade. This exposed surface should be given an application of approximately one-quarter gallon per square yard.

The tar can be applied to the soil by spreading a layer of soil about an inch thick over the road surface and applying the tar to the top of the layer. This is then covered with another inch layer of soil over which tar

Applying tar for soil stabilization.



Mixing tar and soil with Barber-Greene unit.

is applied. The process should be repeated until all of the soil is spread over the road and the tar applied to it, thus building up alternate layers of soil and tar. Mixing is then begun.

Another method is to use a sub-oiler. In this work the entire depth of loose soil is spread on the road and the tar applied through the sub-oiler at the bottom of the loose layer. Somewhat better results are obtained by applying the tar at the bottom of the layer and also midway between the top and bottom. As generally practiced, no mixing is provided, the tar being permitted to percolate to the top of the road. It is believed that better and more uniform results would be obtained by mixing.

Mixing and Compacting

The mixing of the tar and the soil on the road is usually accomplished by the use of disc or spring tooth harrows and power-driven blade graders. Multiple blade drags are also used. A blade grader is generally necessary in any case to shape the road to the proper contour.

There is a field for an efficient mixing machine which will not be too costly and which will efficiently mix the tar and the soil.

Traveling plants which will pick up the tar-coated soil, mix it in a pug mill mixer, and lay it on the road

surface have given satisfactory results. Machines which pick up the soil and mix it with the tar in a pug mill or similar mixer have been used. It is generally necessary to use a rather wet mix and provide time for drying before shaping and consolidating. A power-driven blade grader is probably the most efficient machine for shaping the mix.

Because of the finely divided nature of the soil, better results are obtained if the consolidation is begun at the bottom of the stabilized layer. To do this, a punching or tamping action is necessary. The best available tool at present seems to be the sheep's-foot roller. A multiple truck wheel roller has also been used. The sheep's-foot roller will consolidate all of the depth except for a top layer of about an inch. This loose surface material should be bladed in shape, and the final rolling accomplished with a flat wheel roller. If the flat wheel roller is the only consolidating tool available, the soil should be rolled in thin layers not more than two inches in depth. The consolidating can be done most efficiently when the optimum moisture content is present in the soil.

There is a field for improved consolidating machinery. A tamping apparatus may be the solution.

Surface Protection

To protect the surface and seal it against the admission of surface water, a tack coat of about one-quarter gallon of tar per square yard should be applied to the rolled surface before it is subjected to traffic. The road should be permitted to dry out under traffic until the moisture content is down to five or six per cent before the final top surface is applied.

So far we have been building a foundation. It will stand traffic for a short time, but will soon show surface erosion unless a protective top is added.

The traffic-resisting surface may be a hot tar surface treatment with aggregate cover, or it may be a gravel or stone mixed-in-place top of appreciable thickness. The choice will depend upon climatic conditions and the weight and amount of traffic expected over the road.

Summary

Almost any type of soil can be satisfactorily stabilized by the use of tar so that it will serve as an adequate foundation if properly drained. Admixtures of clay or sand may or may not be necessary. A top—either a hot tar surface treatment or a mixed surface course—must be provided to take the abrasion of traffic and adequately protect and waterproof the tar-stabilized foundation.

Vibration in Placing Concrete

Reasons are given for the increasing use of vibration in placing concrete. The methods of application, the plant used, and the experience gained in various countries are discussed. Vibrators of the surface type are suitable for roads and cycle tracks. The following recommendations are made for their use. Bringing excess mortar to the top of the slab should be avoided, preferably by designing the mix with a low proportion of mortar. Proportions of the mix should be such that sand and water are reduced to make the stiffest concrete that can be quickly compacted with the machines used, at the same time avoiding harshness that might cause honeycombing. Slump, where used as a guide, should be kept under 3 in., and where possible well under 2 in. Careful and constant inspection are necessary to ensure uniform compacting, and to avoid danger of honeycombing due to local incomplete vibration, and segregation due to excessively prolonged vibration. By H. N. Walsh, Civ. Engr. P. W. Rev., 1937, in *Road Abstracts*.

Replacing a Collapsing Bridge Abutment

By Francis L. Brown
Supt. of Highways of Washington County, New York

In the town of Granville, Washington County, New York, is a highway bridge of pony-truss construction with a span of 90 feet between abutments, one of which is built up from the stream bed, which is 50 feet below the bridge floor, while the south abutment was built on a rock ledge about 10 feet below the bridge. Both abutments were built of dry masonry.

The south abutment some time ago showed signs of failure and danger of sliding off the ledge (the 40 ft. face of which is nearly vertical), and the bridge was closed to traffic. The problem was to build a new abutment without removing the bridge. The idea was considered of building a concrete facing, rising from the bed of the stream and passing in front of the abutment and the ledge face below it, but this was considered too expensive, and it was decided instead to remove the old abutment and replace it with an entirely new one. The bridge meantime was supported by bolting it to two 24" I beams, which in turn were supported by two new wing walls which had first been built outside the old ones, resting on the ledge. Then the old abutment was pushed off the ledge into the stream (which is not navigable) and a concrete abutment built on the ledge, to which it was anchored by reinforcement. During the construction pedestrian traffic over the bridge was maintained.

Water Shortage Precautions in Northern New Jersey

In north-eastern New Jersey, in the five counties of Essex, Hudson, Bergen, Passaic and Union, more than 3,000,000 population is served by 34 independent public and private water supply systems. Eight municipalities own the Wanaque supply, and several small ones purchase water from this and from Newark's supply. But not one of eight other major water supply systems in this area, five public and three private, is connected with any others. Some of these sources are more than sufficient for the present needs of those drawing from them, but several of the others are approaching or have already reached the dry-year limit. If all sources of supply could be pooled for the entire area and interconnected, there would be ample for now.

But for the present only. A joint statement of the North Jersey Water Supply Commission and the State Water Policy Commission predicts a serious water shortage by 1945 to 1950 and urges that immediate steps be taken to provide a new major supply, since even then ten years must elapse before such a supply is available. Plans have been made for securing such supply and distributing it throughout the area, and the State Legislature is urged to confer authority to finance it and consolidate the present facilities.

Meantime, to prevent local shortages, immediate interconnecting of supplies is desired. The information necessary to effect this to the greatest advantage of all has never been obtained, but a start is being made with the aid of WPA funds of $13,737 supplemented by $6,650 state funds, under the supervision of H. T. Critchlow, engineer in charge, State Water Policy Commission, with a technical staff of 9 persons and field staff of 23 employed by the WPA.

Welding Standpipe Saves Money

Henry D. Darrow

By HENRY D. DARROW
Supt., Water Department, Kingston, N. Y.

TO improve pressures in the hill sections of the city at times of peak demands, there has been erected at Kingston, N. Y., a welded steel standpipe of 1,000,000 gallons capacity. Kingston has a gravity water supply from the Catskill Mountains conserved in Cooper Lake reservoir which has a capacity of 1.3 billion gallons and is distant 15 miles from the distribution system; an equalizing reservoir holding 12 million gallons is distant 2 miles. The standpipe is on the opposite side of the city from the influent conduit from the mountains and is distant about 0.5 mile.

The standpipe can be operated partly (85%) full floating on the line to smooth out pressures at times of average demands, or can be filled on off-peak hours automatically by booster pumps controlled by an electric clock in periods of high demands (summer sprinkling or waste at house services in zero weather).

The flow line of the standpipe is the same as that of the equalizing reservoir (El. 340) and the bottom is at El. 303.5. The ground at the site is at El. 303 to 308, and the rock varies from El. 301 to 307.

The foundation was prepared by stripping the overburden and taking out all rock that came within 6 inches of the bottom of the standpipe. Fill over the bed rock consisted of rock spalls from the excavation packed and leveled off 6 inches below the bottom of the tank. The interstices and the upper space were filled with sand slushed into place with water. The rock and sand is retained in place by a concrete ring, 12″ wide and from 10″ to 28″ deep with the top 4″ above the bottom of the standpipe, which was anchored to the rock by ¾″ dowels on 18″ centers, set in holes drilled 12″ into the rock. The ring had an inside radius of 34′ 10″, which left about 7½″ between the wall and the standpipe shell, this annular space being sealed watertight with asphalt placed flush with the top of the wall and sloped up to the shell.

What a welded standpipe looks like. Control valves in foreground.

The street to the standpipe is an unimproved lane of rock ledges in a farming district. To provide means for trucking to the site, the Department brought in earth and graded a road of access. To avoid expensive rock trenching in the highway, a pasture was purchased and the 20″ main for about 600 feet was laid in a shallow trench and covered with an embankment which in places projects 4 feet above the natural surface. (Such procedure would be impossible, of course, in highways.) This brought the 20″ main through the shell of the standpipe with its center 18″ above the bottom. To protect the shell at this point from the embankment placed against it, it was given a coat of heavy road oil.

The standpipe has a height of shell of 38′ 0″ and a diameter of 68′ 4½″ inside the lowest plates of the shell. The design was based on shell plate tensile stresses of 15,000 lbs. per square inch, and efficiencies of welds at 80%, with a minimum thickness of ¼″. The shell is butt welded throughout by the electric shielded-arc process. The expertness of the welders was checked in the field by a traveling representative of the contractor who drilled 1″ cores from the welds and subjected them to boiling and etching in hydrochloric acid. The thoroughness of this method of testing during fabrication was shown by the tightness of the shell under hydrostatic tests.

The bottom plates are ¼″ thick and lap welded, with a 2″ lap. They were not painted in the shop, as a better contact with lap joints can be secured by unpainted plates. The plates were laid directly on the sand foundation and the joints were welded on the upper side only and tested by wirebrushing bright all seams and inspecting welds with a magnifying glass for defects. Inside and outside ⅜″ welds were used at the junction between bottom and ring plates.

The vertical edges of the three bottom rings were beveled 30°, the two top ¼″ rings had square edges with ⅛″ weld space. At the girth seams, all edges were square except the bottom of the second ring (double 45° bevel) and the bottom of the third ring (one 30° bevel).

The roof is of conventional design, supported by sixteen main rafters about 34′ long consisting of 8″ channels (11.5 lbs.), trussed, with bolted members. At the center of the standpipe the main rafters are supported by a single column, being bolted to lugs spot-welded to a 24″ diameter x ⅜″ cap. The column consists of a 10″ channel (15.3 lbs.) with an 8″ channel (11.5 lbs.), spot welded at right angles to its web by 24 welds, ¼″ x 2″ on both sides. There are sixteen intermediate rafters consisting of 8″ channels (11.5 lbs.), about 17′ 3″ long. All rafters are connected to the shell by 2 bolts to lug angles welded to the shell.

The roof is made up of 3/16″ plates of copper bearing steel (containing 0.25% copper) lapped 1″ and

continuous welded on top and to a 3″ x 3″ x ¼″ top angle. The roof is conical shaped on a slope of 1½″ on 12″, with no finial.

The shop coat for all water-contact surfaces and the rafters, column and underside of roof, was Bitumastic solution. After the standpipe had been tested and emptied, the field coatings were applied by Wailes Dove Hermiston Co. On the rafters, the column above high water and the underside of the roof, both priming and finishing coat were of Bitumastic solution applied cold. The shell and bottom received a cold Bitumastic priming coat and a field coat of Bitumastic enamel applied hot. The hot coating was applied during the very warm weather in the middle of July. Troubles from heat and condensation were encountered which might have been lessened had there been more ventilation openings provided in the roof and shell. Work had to be limited to the night on account of the heat; blowers and blow torches had to be installed to keep down the condensation, which seemed to be concentrated on the underside of the roof. These helps proved effective. Tests of the finished coating by cutting out 1½″ squares on July 22nd at about 10 locations showed that the thickness ran closer to 3/32″ than to the specification requirement of 1/16″. The outside of the tank was painted with one shop coat of red lead and two field coats of Dixon's gray graphite.

Bids were received on the welded steel standpipe on March 24th and it was completed on July 24th by Chicago Bridge & Iron Co. at a cost of $15,975. Bids on a riveted standpipe ran about $1,000 higher. The foundation cost $2,000 by day labor. Sanborn and Bogert were consulting engineers on the standpipe and other west side improvements, which were installed by the writer assisted by E. I. McCaffery, resident engineer for the consultants.

Patented Sewage Treatment Processes in Minnesota

DURING the past year Prof. H. O. Halvorson, of the Bacteriology Dept. of the University of Minnesota, has been studying a process of sewage treatment that involves the use of the "high-rate" trickling filter developed by him and also a modification in the primary treatment. Using private funds, he has constructed at River Falls, Wis., a plant for studying the process large enough to handle all the sewage from that community's 3,000 population. In this plant a screen is used in place of a primary settling tank and the sludge, undigested, is dried directly on sand beds. The sludge is handled daily and the sand beds are small.

Concerning the matter of patenting the processes developed by him, he says:

"It has been necessary to finance my researches with private capital, and therefore the processes have had to be protected by patents, which have been applied for. If they are allowed, a nominal license fee will be charged at the time the plants are constructed. The scale of charges will be somewhat lower than those that were levied against the activated sludge process. A portion of these license fees is to be used to retire the capital that was used in the investigations. Thirty per cent of my share of the license fee is to be turned over to the University, with the understanding that it is to be used for the support of researches in the field of sanitation, or in fields closely allied. It is hoped that this will create a fund which can be used to support similar researches in the future, obviating the necessity of enlisting private capital."

Several members of the League of Minnesota Municipalities which are contemplating using these or other patented processes have asked the State Board of Health concerning its policy with regard to the approval of new treatment processes, to which the board has replied:

"It has been the policy of the Department to encourage the development of new processes which show promise of success. But before plans for municipal sewage treatment plants involving new processes can be approved, the Board requires that the process must have been thoroughly tested and found to be satisfactory in a full-scale plant. Ordinarily, at least one year of successful operation under normal operating conditions will be necessary to demonstrate the success of an installation.

"No general approval will be given by the board of any treatment process; conditions differ in the various municipalities and each proposed installation must be considered individually. If a municipality is willing, however, to assume full responsibility for a demonstration plant, and adequate guarantees are made that necessary changes will be made in case the installation proves unsatisfactory or inadequate, such plant may be installed.

"Where any unusual design or a new process is contemplated, it is desirable to submit detail information and preliminary plans for consideration in advance of the submission of final and complete plans and specifications, including all information necessary to a full understanding of the proposed project.

"This policy of the Board, which we have outlined, is based upon the experience of the Department, and has served in several instances to protect municipalities from installing treatment processes and equipment which have subsequently proved unsatisfactory and have been abandoned by their proponents."

Developing a Well With Dry Ice

A WELL with 14″ casing for 150 ft. and 10″ for 280 ft. below this, at Orland, Calif., passed through only one water-bearing stratum — gravel packed with clay which gave only 60 gpm with an 85 ft. drawdown. The well driller did not think the well could be developed with either dynamite or glycerine, due to the tightly packed nature of this stratum, and F. C. Pratt, superintendent of the water works, decided to try dry ice. He describes the procedure in "Johnson National Drillers Journal" as follows:

"We put in a preliminary shot of 150 pounds of dry ice to carbonate the water. This shot took about twenty minutes to finish working, but had very little effect, as the water absorbed most of the gas formed.

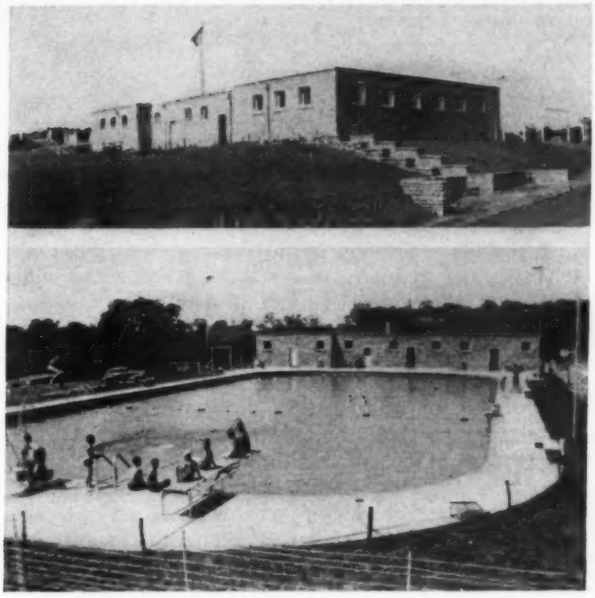
"The next shot of 150 pounds we pulverized to two-inch and smaller pieces. Within about three minutes, this shot blew a column of water the size of the 14-inch casing approximately thirty feet into the air. It emptied the well of water. As more water ran into the well through the perforations, this action was repeated until the dry ice was exhausted. This occurred three times.

"The final shot of 200 pounds of pulverized dry ice blew the column of water about ten feet higher into the air. We could tell that the water was running into the well faster, as these explosions were being repeated at more frequent intervals.

"After this treatment with the dry ice, the well, upon being tested, delivered 800 gpm with a drawdown of 15 feet. This was the capacity of the test pump. When the new pump was installed and allowed to pump on the ground, the well delivered considerably more than 1,000 gpm with a drawdown of only 10 feet."

Oskaloosa's Municipal Swimming Pool

By Don B. Russell
City Engineer, Oskaloosa, Ia.



Two views of Oskaloosa's swimming pool.

OSKALOOSA, Iowa, on July 3rd, 1937, opened a swimming pool which had been under construction since July 9th, 1936. Payment for the pool was met by an issue of $20,000 in swimming pool bonds and a WPA grant of $25,000. Although the pool was operated only 66 days this year, during which precipitation occurred at such times as were most damaging to pool attendance, and the season was unusually cool (average temperature 77.4°), the gross revenue was about $2,600. This was obtained by charges of 25 cents admission for adults and 10 cents for children of 12 and under, with season tickets costing $3.50 and $2.00, respectively. This charge included the services of checking clothing and a towel—extra towels 5 cents each. No bathing suits were rented and no concession operated. Tuesday and Thursday mornings were free to children of 14 and under. Omitting the free mornings, a graph of temperature and attendance shows a direct relation between the two.

The pool measures 75x150 ft. with corners rounded to an 18 ft. radius. Facing the west end of the pool and separated from it by a 25 ft. walkway is a bath house 100 ft. wide, consisting of a central building about 45 ft. square between two wings which project a few feet beyond it both front and rear. The central building contains a lobby, check room and water purification plant. The wings, each about 1,400 sq. ft. area, contain the dressing rooms, shower baths and toilets. In the women's side are 24 dressing booths in the center of the floor space, in two rows of 12 each, back to back, with a shower common to each abutting pair; four toilets, two lavatories, a large double make-up table equipped with mirrors and bench, a wringer and sink, which have proved to be fully sufficient. In the men's side there are 12 dressing booths, placed near one end, 8 showers in a common shower room, three toilets, three urinals, two lavatories, wringer and sink, and two long dressing benches. A footbath is so situated in the doorway of each room that it is impossible to pass either way through the door without foot sterilization.

Instead of expensive lockers which demand much room space, constant sterilization and endless upkeep, the Bemis bag system was installed. This system allows the clothes to hang in light and air from racks made of ordinary ¾" pipe and in wetproof canvas bags. The bags are ingeniously fitted about a wooden clothes hanger; the rung makes a neat hand for men's pants or women's dresses, and the outside offers a form for the coats. Shoe pockets are arranged on the front outside, and the large pocket which forms the bag will hold any miscellaneous articles. These bags hang in a central check room accessible from the dressing rooms by service windows. This makes the total checking room space—racks and all—occupy only 650 souare feet. Infrequent laundering keeps the bags reasonably sanitary, and a season's wear isn't noticeable.

The depth of water in the pool varies from 28" at the west end to 9 ft. 6 in. near the east end, the water level being kept about 3" below the scum gutter lip. This keeps about 475,000 gallons of water in the system, including pool, recirculation lines, filters, mixing basin and wash water lines. Nearly 10,000 gallons of additional water is supplied each day, the major portion for backwashing the filters, but some for the showers, interior cleansing, washing runways and walks, flushing toilets, drinking fountains, water lawn areas, overflow, splash and evaporation.

The recirculation and purification system consists of a rapid sand filtration plant, recirculation pump, wash water pump, inlet and outlet lines, 28 scum gutter drains, 4 main outlet drains in the bottom of the deep end, and 10 inlets—3 on the deep end and 7 about the shallow end. The pool is filled from the city water supply, a 4" main from which discharges into the mixing basin, where chemicals are added and mixed. Then the water passes by gravity through the 27" of sand (in the filters) and 18" of assorted layers of gravel, into the cast iron laterals and manifold, from which it is pumped through the recirculation line into the pool through the 10 inlets. Chlorine is fed directly into the recirculation line.

The scum gutter drains and the pool bottom drains are connected to a manhole, and the drainage water may be allowed to return to the mixing basin by gravity for recirculation or may be directed by valves to a storm sewer. Water from the pool enters the mixing basin by gravity, receives the chemicals from the dry-feed machines, which are mixed with it by means of a mechanical agitator, and recirculates through the filters and into the pool. To wash the filters, the recirculation line valves

are closed, and the wash water pump brings water from the pool into the manifold of the filters; this water, after washing the fllters, draining through a storm sewer to the creek.

Native stone was used to build the 52′x100′ bath house. The only finishing applied to the inner side of the stone walls was a waterproofing made of a mixture of lye, alum and pure cement in water. All of the inner partitions are made of 8″x12″ clay building block and finished with aluminum paint. All counters, windows, bag racks and wooden fixtures are finished with aluminum paint. Floors are of concrete with numerous floor drains.

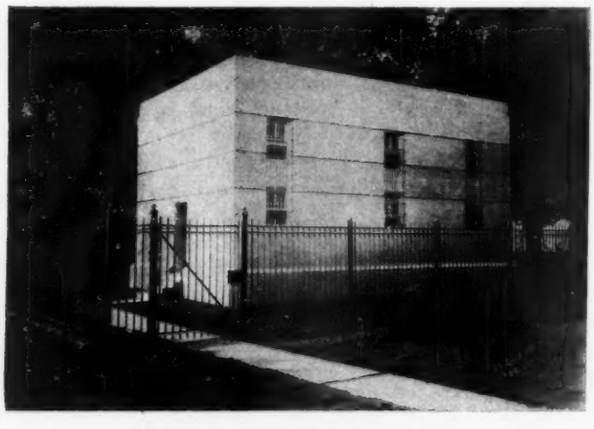
The 10″ pool wall and scum gutter were poured as one unit up to within 5″ of the sidewalk grade. The wall reinforcing ran into the sidewalk and the walk reinforcing was tied onto the wall reinforcing. All ladders were set in the sidewalk and anchored at the bottom into the pool wall. The life-guard chair, 2 one-meter boards, and the three-meter board were all set in sockets placed in the concrete sidewalk. (The ideal solution is to block out the walk for these units and pour them after the sockets and equipment are set up in place.) Two cork life-lines were fastened in the wall above the scum gutter by means of brass sleeves and screw eyes. This was set in the wall after the wall had been poured.

At the east end of the pool (the deep end) the sidewalk is carried from the normal 7 ft. width of the sides to a 13 ft. width attained by eccentric radii, instead of the ordinary reverse curve method of increasing the end width to accommodate the diving boards at the deep end.

Four steel standards 26 ft. long are placed on the sides and just back of the sidewalk, each supporting a double reflector which contains two 1,000 watt globes. This gives the entire system 8,000 watts, which is a very satisfactory light for the pool itself. The cost of light and power for the pool and bath house averages about $3.50 a day.

Stone-faced bleachers border the pool on the north. An attractive concession building using native stone wherever tasteful will evolve also on the north side of the pool. Additional landscaping will create a parking area accommodating over 200 cars and more lawn areas have been seeded.

The rules for sanitation observed by the pool staff and urged upon the public are those suggested by the Iowa State Department of Health. A weekly report blank covering recirculation, amounts of chlorine, lime, soda ash, alum and copper-sulphate used, length of filter run in hours, cleaning and filling of footbaths, lavatories, stools, urinals, showers, algae in pool, cleaning of pool, cleaning of runways, cleaning of bath house, and average of residual chlorine (to be tested four times daily), is sent for approval of the State Department of Health. The regulations (also suggested by the Department of Health) include rules requiring a bath before entrance to the pool; footbaths are required upon each journey to and from the pool; skin diseases, sore eyes and colds are barred; open cuts and raw blisters are excluded as much as is possible; spitting and blowing the nose in the pool is discouraged; divers are urged to wear protective helmets or ear plugs; rough play is controlled and eliminated where possible; and janitors are given instructions in the proper sanitation and cleansing of the various public passageways.



Webster City's remodeled prison.

Recovery on Quantum Meruit

The Florida Supreme Court, in Webb v. Hillsborough County, 175 So. 874, applied as an exception to the rule of nonenforceability of ultra vires contracts the rule that if a county enters into a contract for a public work which it is authorized to construct and the contract is executed in good faith, after which it develops that the county cannot issue lawful certificates in payment therefor as contemplated when made, if the county is in the enjoyment of the fruits of the contractor's expenditure he may recover in an action against the county on a quantum meruit for the value of the work done and the materials furnished.

It was also held that quantum meruit is not a legal concept inducted from a vacuum, but it arises from all the facts that compose the matrix in which it is found. When so applied, the value of the work done and materials furnished is not necessarily limited to manual labor and wood, sand, iron, and physical materials furnished, but may comprehend the cost of engineering, superintending, or any necessary expense that goes into and becomes a part of modern highway construction.

An Old County Jail Modernized

PLACING an 8-in. reinforced concrete jacket over the old county jail at Webster City, Iowa, recently, solved one of the problems which had been facing Hamilton County officials for several years. While the old jail was perfectly satisfactory as far as the prisoners were concerned, many of whom had escaped by pushing their way through the hollow tile and brick outer walls, the grand jury insisted that more secure quarters be constructed. Other residents of Hamilton County, however, by rejecting a proposed bond issue to erect a new jail, forced the county to adopt an economical method of making the old building escape-proof.

The single layer of brick veneer, which had failed to hold the more determined prisoners, was stripped from the building and an 8-in. reinforced concrete wall placed directly against the back-up tile. Tool steel bars placed over the windows, in addition to being embedded in the concrete, have their ends fastened to the reinforcing steel surrounding the window openings.

While concrete was originally selected for the modernization of the jail because of its low construction costs, the adoption of a design embodying simple modern lines, combined with good construction procedure, made this new shell attractive as well as practical. Carefully matched forms were filled with correctly proportioned concrete which, when rubbed with a carborundum stone as soon as the forms were removed, produced an even textured, durable surface. The cost of the modernization, including the removal of the old facing, was only $2,890 and, according to Sheriff James L. O'Malley, has made the building escape-proof.

The Editor's Page

The ARBA Does a Good Job

The Road Show that has just gone into history was a notable one. We doubt if any technical association has ever before performed the service to its industry that the 1938 Road Show did. It gave a lift to the spirits of the highway construction personnel, especially the manufacturers, that was sorely needed. The deep blue, which had been the prevailing color in the highway field for the two or three months preceding, was converted into a rainbow of promise. At least, so it seemed to one observer. So, thanks and congratulations, ARBA.

Thank You, Mr. Sheets

In connection with an article published last month describing the methods employed by the city of Cleveland, O., for ice control, we, with a slight tendency to levity, asked Mr. Sheets to guarantee the weather for the Road Show. Someone did a fine job with the weather. No one could have asked for a better week. We are sure that the many thousands who were in Cleveland from the 17th to the 21st will join in their appreciation of the weather and of the many courtesies extended by the convention city.

What Are Highway Guard Rails For?

Our perhaps elementary understanding of highway guard rails has always led us to the conclusion that they were safety factors, designed to protect the traveling public from hazards at certain danger points along highways. Unfortunately, much competition has developed among various manufacturers, and this competition seems to have reached the point where some engineers are either confused or are bewildered by patents and patent suits, or threats of them. In some cases specifications have gotten tangled up, too. Personally we don't know much about writing specifications for guard rails, and in the present state of affairs we don't crave the job of writing them; nor of buying guard rails either. Isn't it about time that one of our stronger technical associations appointed a top-notch committee to so straighten out these matters that the buyers of guard rails can give first consideration to the matter which is of first importance—the safety of the traveling public?

Very Sound Engineering

Some time ago a state highway department decided to order a couple of bituminous distributors, and in awarding the order for them took a notable step forward. The engineer in charge felt that the equipment owned and operated by the state should set an example, for quality and ability to do good work, to the contractors who perform much of the highway construction work for the state, and to the counties and other governmental units that are, naturally, influenced to a considerable degree by what the state does.

Accordingly, orders were placed for these two distributors on the basis of what they could do, and not on the basis of how cheap they could be bought. This is a sound policy, and it ought to be employed on a much wider basis. The custom of awarding contracts to the lowest bidder is a good one, when all equipment and all materials are equal; but this, so far as construction equipment goes, is not always the case. In construction, good equipment and good materials are necessary to do a good job. If more engineers had the courage to set an example by buying the best that is obtainable, it would no doubt pay very high returns in the long run.

Costs and Values of Water Service

The actual value of public water service is always many times more than it costs. Those charged with the responsibility of maintaining such service should aim to do everything, in original planning and afterwards in maintenance, to keep a lap ahead of trouble. Every water work should be organized and equipped to meet emergencies. If the cost of maintaining a complete line of equipment, tools and materials for immediate use in cases of emergency is ever justified, it is in water work operation. This is true not only from the viewpoint of maintaining continuous service, but also as a matter of health protection.

Fortunately, such equipment, tools and materials are not excessively costly, and are within reach of many of the smaller communities. What they are, and how they are used are described in an excellent article by Mr. Blomquist on another page of this issue. The thoughts expressed above are largely his, but they are so widely applicable that we have taken the liberty of expressing them again on this page in a slightly different dress.

Aluminum Sulphate, Hydrogen Sulphide and Sewage

In the development of any new process, difficulties are met with which must be solved before further progress is made. We have published several articles on the use of aluminum sulphate as a sewage coagulant, a matter in which we have been much interested. A difficulty developed at two plants due to poor flocculation at certain hours of the day. As a rule, there is sufficient alkalinity in sewage to react with aluminum sulphate, and tests showed this was not the cause of the difficulty.

The mischief maker in at least one case apparently has been hydrogen sulphide. Its presence in water, when lime is used with aluminum sulphate, does not affect the floc; but in sewage it does prevent proper flocculation. The amount that will cause trouble is not definitely known. Further experience will doubtless determine this limitation. In the meantime, prechlorination to prevent the formation of hydrogen sulphide, and precautions in getting the sewage to the plant in as fresh condition as possible, seem to be most effective. Apparently only a small amount of chlorine is necessary, considerably less than enough to satisfy the chlorine demand.

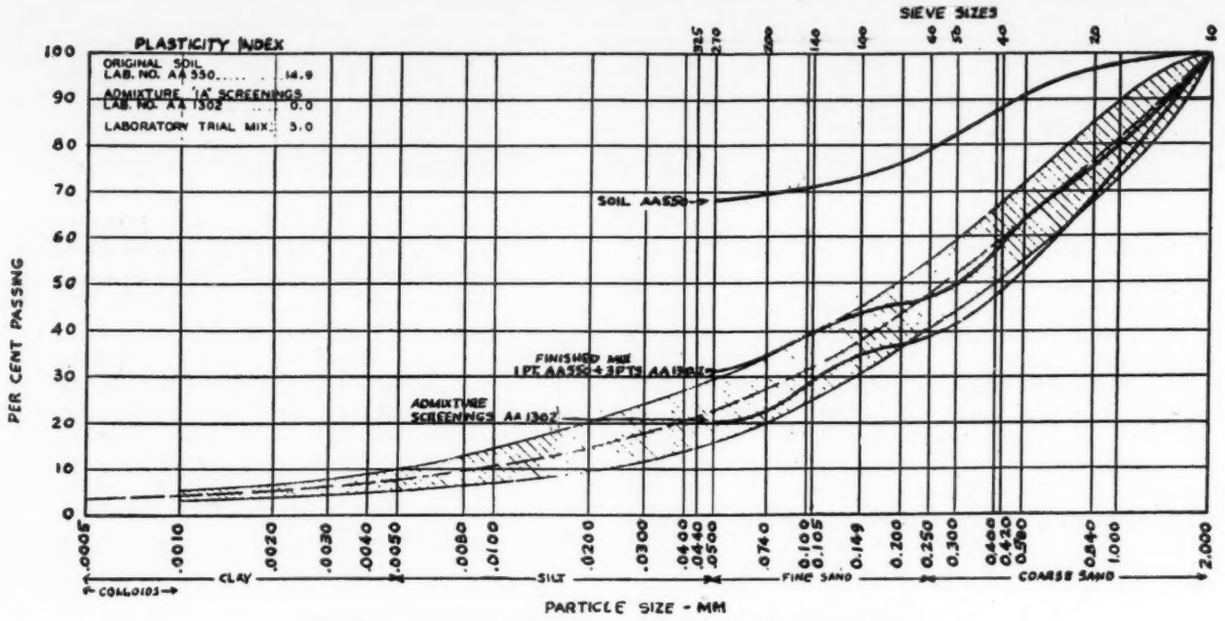


Fig. 2. Curve of grading requirements for stabilized materials

Soil Road Stabilization Design and Construction

G. A. RAHN
Research Engineer, Pennsylvania Department of Highways

WHAT you are about to read is a description of a typical soil road stabilizing set-up and construction, peculiar to a state having materials and resources similar to those of Pennsylvania, realizing that where materials or their availability change, set-up and construction must necessarily change; this will call for the introduction of new methods, equipment and materials. Various processes are in the course of development in different sections of the country at the present time and will bear watching, as their development and possibilities are interesting.

First it is necessary to keep this pertinent thought before you—this is a low cost road which means that you cannot tack on too many doo-dads or gimcracks, commonly known as refinements, and still keep it in this category. Neither is it intended for trunk line traffic in populous communities, but for the light traffic roads and for the smaller political sub-divisions who do not possess the means for expensive construction and maintenance; in other words, speaking to State Highway men, shall we say feeders for your primary or secondary road system. There is going to be disagreement on this: that's fine—but think it over, let's creep before we walk. Too frequently an innovation with merit is seized upon as a cure-all, jammed into all types of breaches with resulting failure, and as a consequence is damned as a misfit, discarded and given no further consideration. Let's guard against this and accept the inevitable formula, that as traffic increases maintenance increases, also that traffic increase demands a higher type of pavement and for this higher type of pavement the stabilized roadway will provide an excellent sub-grade and material for shoulders. At present we are not in a position to predict the future of this youngster of the highway field, suffice to say we have attacked the problem of solving the mystery of a material we have so much of and know so little about—dirt.

Through recent developments[1] in the technique of soil testing it is now possible to classify soils and consequently design for their improvement. This procedure is summed up in the following statement[2]:—

> "The process of building stabilized soil road surfaces consists, first, in arranging the most stable combination of the available materials, and, second, in providing for as great a degree of permanence of that stability as is possible by means of mechanical consolidation and the use of admixtures or waterproof coverings."

In this article we will deal with the primary or basic method which has to do with the introduction of the properties lacking in the existing soil and will build up this procedure accepting the following basic facts:—

[1] "Report on Subgrade Soil Studies," U. S. Bureau of Public Roads.
[2] "Introduction" to the Progress Report of Project Commmittee on Stabilized Soil Road Surfaces of the Highway Research Board, National Research Council, 1935.

1. The phenomena governing soil stabilization are internal friction and cohesion.
2. The densest mass of a given material is always the most stable.

Sands possess internal friction, clayey soils possess cohesion, which suggests that a proper combination of the two would give or approach the stable soil mass. This is correct to a certain point where the problem of maximum density enters the picture, which means that the element of gradation must be given consideration in order to insure the greatest maximum density.

The statement was just made that the stable mass is composed of a sand-clay combination, but it does not necessarily follow that sand alone may be used to obtain a stabilized mixture. Stone, slag and gravel in various sizings, shales and various forms of industrial wastes, such as coal and coke cinders, reddog, quarry waste, etc., all have their place in the scheme of things when used discriminately. In other words, shales and industrial wastes are not considered in the same class as the stones, slags, gravel and sands, and the mix and stabilized surface course or courses should be designed with this thought in mind. Again in the case of the clay it is not intended to convey the idea that straight clay is necessary for the binding medium. A clayey soil containing sand and silt in addition to the clay works equally well and is more easily broken down and dispersed through the mix than a straight clay soil; in fact, as in the case of base courses, I believe the binding element represented by the clay can be eliminated and a soil substituted which is limited to the requisite grading requirements alone.

Set-Up and Procedure

Proceeding we will take a page from the Pennsylvania specifications headed "Design of Mixtures." A few minutes study of this skeleton outline will give you a fair idea of the materials which can be used in this set-up, see Table 1, also Figure 1.

You note that the designs run from fine to coarse. Accepting Design No. 1 as the basic mix you will see how it is used to build up Design No. 2 and Design No. 3A. This is possible because the fine graded mix (Design No. 1) runs from fines to an approximate top of 5/8-inch, while in Design No. 2 (which is merely the addition of graded coarser material) this is carried through to an approximately top size of 1-inch or 1¼-inches, while in Design No. 3A this same mix (Design No. 1) is used in conjunction with the coarse material in a 50-50 mix.

Surveying.—Our problem in the field is: first to determine the type of soil which is to be stabilized, and then look for a suitable material to combine with it to produce the stabilized mix.

We will assume there is to be no change in line or grade and the present roadway is to be stabilized. Your first job is the preliminary survey and sampling, and for this purpose the following procedure will prove a guide.

Go over the project carefully and note visually the general nature of the soil and the change in soil formations.

Return to the start of the project. From this point make a closer inspection of the various formations. This can be done visually and through the feel of the material as found in the banks or the roadway. After the limits of each formation have been definitely established, a composite sample representative of each formation should be taken. The composite sample weighing between 50 and 75 pounds should be collected from various points in each formation. If there is no change in the formation, take an accumulative sample of six or seven locations per mile.

The size of sample can be reduced in the field by screening out the larger sizes, noting their size and quantity, as only the material passing the 1-inch or 1¼-inch screens, in amount of 8 to 10 pounds, are necessary for laboratory determination.

Analyzing.—These samples are taken into the laboratory and analyzed on a basis of physical constants and gradation.

Before going any further a few things should be said regarding various groupings constituting the soil mortar or the material passing the No. 10 mesh screen, as this material is the heart of the stabilized road. (See Fig. 2.) These groups are:

TABLE #1

Design of Mixtures
(See Cross Sections Figure 1.)

Design No. 1 – Binder Soil[1] or Soil[2] + Screenings (fines to 3/8" or 5/8")
or
Binder Soil or Soil + Sand (200 mesh to ¼" or 3/8")
or
Run of Bank Stabilized Soil[3]

Design No. 2 – Design No. 1 + Graded Coarse Aggregate (5/8" to 1" or 1½")

Design No. 3 –
Bottom Course "A" = Design No. 1 + (Coarse Material)[6]: Coarse Reddog, or Coarse Shale, or Coarse Gravel, or Coarse Stone, or Coarse Slag, or Other Coarse Material
or
Bottom Course "B" = Soil + (Graded Material)[7]: Graded Reddog, or Graded Shale, or Graded Cinders, or Graded Gravel, or Graded Stone, or Graded Slag, or Other Graded Material
Top Course = Design No. 2

Design No. 4 – Run of Bank Gravel[4] + Binder Soil

Design No. 5 – Run of Bank Stabilized Gravel[5]

Table 1. Data below give details of design

[1]*Binder Soil.* The binder soil consists principally of fine soil particles, but may contain larger size fragments provided their size does not exceed the allowable maximum size for the specified design. It should be reasonably free from organic matter, and possess such binding qualities that, when combined in the specified proportions with non-plastic granular materials, it will impart the required plasticity and aid in the gradation of the finished stabilized mixture.

[2]*Soil.* Soil consists principally of fine soil particles, but may contain larger size fragments provided their size does not exceed the allowable maximum size for the specified design. Soil differs from binder soil in that it need not possess binding qualities, it must, however, be so graded that it will aid in the gradation of the finished mixture.

[3]*Run of Bank Stabilized Soil.* Where tests indicate that a soil deposit possesses the necessary characteristics of a stabilized mixture of the required gradation and plasticity, this material may be used without admixture for Design No. 1, or with admixture to conform with the grading requirements of other designs.

[4]*Run of Bank Gravel.* Where tests indicate the suitability of a gravel deposit for combination with a binder soil, and provided it does not contain an excessive amount of flat and elongated pieces, this material may be used as indicated.

[5]*Run of Bank Stabilized Gravel.* Where tests indicate that a gravel deposit possesses the necessary characteristics of a stabilized mixture, and provided it does not contain an excessive amount of flat and elongated pieces, this material may be used without or with admixture, as indicated, to conform with the grading requirements of the specified design.

[6]*Coarse Material* in this case shall be construed to mean a material composed of larger particles, two (2) to three (3) inch size, with no appreciable amount of fine material (passing No. 10).

[7]*Graded Material* in this case shall be construed to mean a material composed of coarse (maximum size three [3] inches) and fine particles, with an appreciable amount of fine material (passing No. 10).

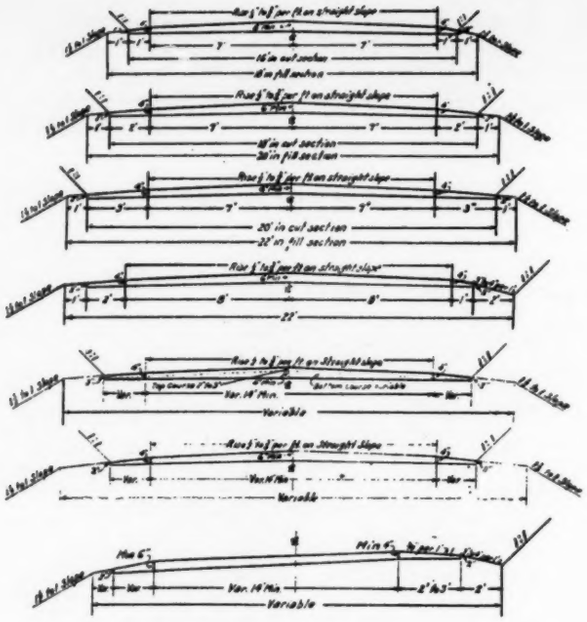


Fig. 1. Cross-sections of stabilized roads. Four top sections show standard widths and depths; fifth from top is 2-course; next one below is one-course construction. Bottom section shows method of super-elevation on curves of more than 5°.

Coarse Sand from 2.0 mm. (10 mesh) to 0.250 mm. (60 mesh).
Fine Sand from .250 mm. (60 mesh) to .050 mm. (270 mesh).
Silt from .050 mm. to .0050 mm.
Clay below .0050 mm. and
Colloids below .0010 mm.

Analyzing this combination we see that it is composed of a material that possesses internal friction on the part of the sand fraction and also a material that possesses cohesion as represented by the clay and colloidal fractions. You will note there is an apparent gap between the sand fractions and the clay fractions given under the head of "silt." Taken alone this material is a bad actor, but can be made an asset when used within the limits indicated on the gradation chart, because in these proportions it acts as a filler or embedding medium for the sands, while the clays and colloids act possibly as a filler, in any event as the cohesion producing or binding medium.

This cross-hatched curve on this chart is representative of the grading requirements of the ideal soil mortar, or the one which possesses the greatest inherent stability and density, and is the one which we strive to equal or approach in our design of soil mixes.

Upon arrival of the soil samples in the laboratory they are submitted to test, and their gradation[3] and plasticity[3] determined; as the design of the mix is dependent upon these two very important determinations.

Computing.—After the preliminary work has been performed, the soil gradation is noted on the soil-mortar gradation chart as indicated in Fig. 2, (curve noted "Soil"). The admixture proposed for use in this work is also plotted (curve noted "Admixture") and a mixture calculated which will fall within, or approach the master curve, which is indicated by the cross-hatched area, (curve noted "Finished Mix"). The proportion of soil and admixture determined upon in this computation is returned to the Soil Laboratory and the Plasticity Index determined. If this is found to be satisfactory, the proportions are reported back to the field, and these form the basis of the preliminary estimate for a particular project represented by the samples in question.

This is the set-up used in computing the fine graded mix or Design No. 1, the other mixes are developed in like manner with emphasis placed on correct gradation of the soil mortar fraction (passing No. 10 sieve) in every case. Oftimes it is economically necessary to disregard the gradation above this size, as in the case of bank run gravels, waste piles, etc., but the soil mortar sizing cannot be disregarded.

At this point we will digress a bit. As noted in previous paragraphs, the admixture will consist of either a granular material or a binder soil, depending upon the character of the soil which will be found in the finished roadway, i. e. if you have a highly plastic soil in the roadway, it will require a granular material be mixed with it in order to arrive at a satisfactory gradation and plasticity. If, on the other hand, the material in the finished graded roadway is granular in nature and lacks in plasticity, then a binder soil possessing the necessary plasticity will form the admixture.

Now, with this thought in mind, at the time when making the preliminary survey, it is advisable to be on the lookout for both granular and binder soil admixture sources, forwarding them to the laboratory at the time of making the preliminary survey. This will save time both in the field and in the laboratory as work can immediately be started on computing the mixture and determining whether or not the admixtures forwarded will be applicable to this particular project.

Construction Procedure

Shaping and Maintaining Roadway.—The existing roadway should be shaped to the required cross-section and kept in a smooth condition free from ruts and depressions. No material should be placed upon an excessively wet or muddy roadway.

When the stabilized roadway is constructed in two courses, in which the quality of the materials are varied for each course, the mixing and placing operations may be carried on in both courses in sections of convenient length, but each course should be completed before material for the succeeding course is placed. Each course should be maintained in a smooth condition, true to cross-section and free from irregularities, until the succeeding layer has been placed.

If dry, the prepared roadway should be moistened uniformly prior to placing the stabilized surface course.

In the event that ruts are formed extending through the stabilized surface course and into the original roadway, all the stabilized material should be removed from the area affected, and the original roadway surface restored to its proper cross-section before replacing the stabilized surface course.

Proportioning Mixtures.—When the tests show that the existing material in the roadway is to be used for either granular* or colloidal** material it may be windrowed to the edge of the roadway, and the amount necessary to provide the quantity needed from this source determined by volume through gauging the windrows. In removing this material, care must be taken to preserve the established crown of the graded roadway.

[3]Gradation, Plasticity Index and Liquid Limit as determined by the physical test methods of the American Society for Testing Materials D423-35T and D424-35T, or American Association of State Highway Officials Method T89, T90 and T91.

* Granular material is construed to mean suitable sand, crushed stone, crushed slag, gravel, reddog, cinders, shale, etc.
** Colloidal material is construed to mean a suitable binder soil, clay or other pastic materials.

When granular or colloidal material or both are secured from other sources, the required quantities can be determined by volume or weight, depending upon facilities available.

The quantities of granular and collodial materials entering into the construction are based on the weight per cubic foot of the finished stabilized mixture; this is assumed at one hundred and forty pounds, with the following exceptions:—

Admixture	*Weight Compacted Stabilized Mix*
Stone, sand, gravel or shale	140 pounds per cubic foot
Slag	125 pounds per cubic foot
Reddog	115 pounds per cubic foot
Cinders	105 pounds per cubic foot

Preparing Colloidal Material.—Where the colloidal material does not break down readily under the usual means of handling (scarifying, blading, excavating, loading, dumping), it should be allowed to dry, then broken down by means of suitable equipment (disc harrows, soil pulverizers, rollers, etc.) The breaking down process to continue until the material is reduced to a state, reasonably free from lumps, where it will mix readily and uniformly with the granular material.

Mixing.—The granular and colloidal material may be placed in windrows or spread in a manner convenient to the particular type of mixing method employed, then thoroughly mixed until a uniform mixture is obtained.

Road Mixing.—When mixing is done on the road surface it may be accomplished by blading or harrowing or through a combination of the two methods. Care is taken that the existing roadway, or the several courses, in the case of two-course construction, shall not be disturbed in the mixing operation. Mechanical road mixers, multiple blade maintainers or other similar mixing equipment may be found useful.

Plant Mixing.—Mixing operations may be performed at either a central mixing plant or a portable mixing plant in lieu of road-mix methods. They should be capable of producing a material meeting all requirements of the stabilized mix. If plant mixing operations are used water and other agents assisting in stabilization can be combined with the mixture at the plant.

Distributing.—After mixing is completed the stabilized mixture should be windrowed, half on each side of the road.

Spreading and Compacting.—The stabilized material should be spread uniformly in layers between three and four inches loose depth, shaped to the required cross-section, moistened sufficiently to insure proper compaction, then compacted. Where the finished stabilized mix is delivered to the project it may be spread with spreader boxes, or by other suitable methods. Compacting may be performed by means of three wheel ten-ton rollers, multiple pneumatic tired rollers, or other satisfactory types of equipment. Rolling or other methods of compaction to continue until the mixture has been uniformly compacted to a satisfactory density. The spreading and compacting operations to be repeated until the required amount of material has been placed. Before moistening the last layer the surface should be smoothed and shaped to the required cross-section by means of blade graders or drags or both. Pieces of coarse aggregate larger than the maximum size permitted in the surface course should be removed from the top two inches. This can be done by means of rakes, stone forks or by mechanical means after the material has been spread or by screening prior to placing. Compaction and shaping of the surface, supplemented by periodic wetting, should be continued for a period of ten days.

If the mixed materials become wet from rainfall they may be spread over the prepared roadway in shallow courses (approximately 3 in. loose), shaped and compacted while drying takes place. A harrow may be used to expedite the drying. Shaping and compaction to continue until the moisture has decreased to a point at which the mixture becomes firm.

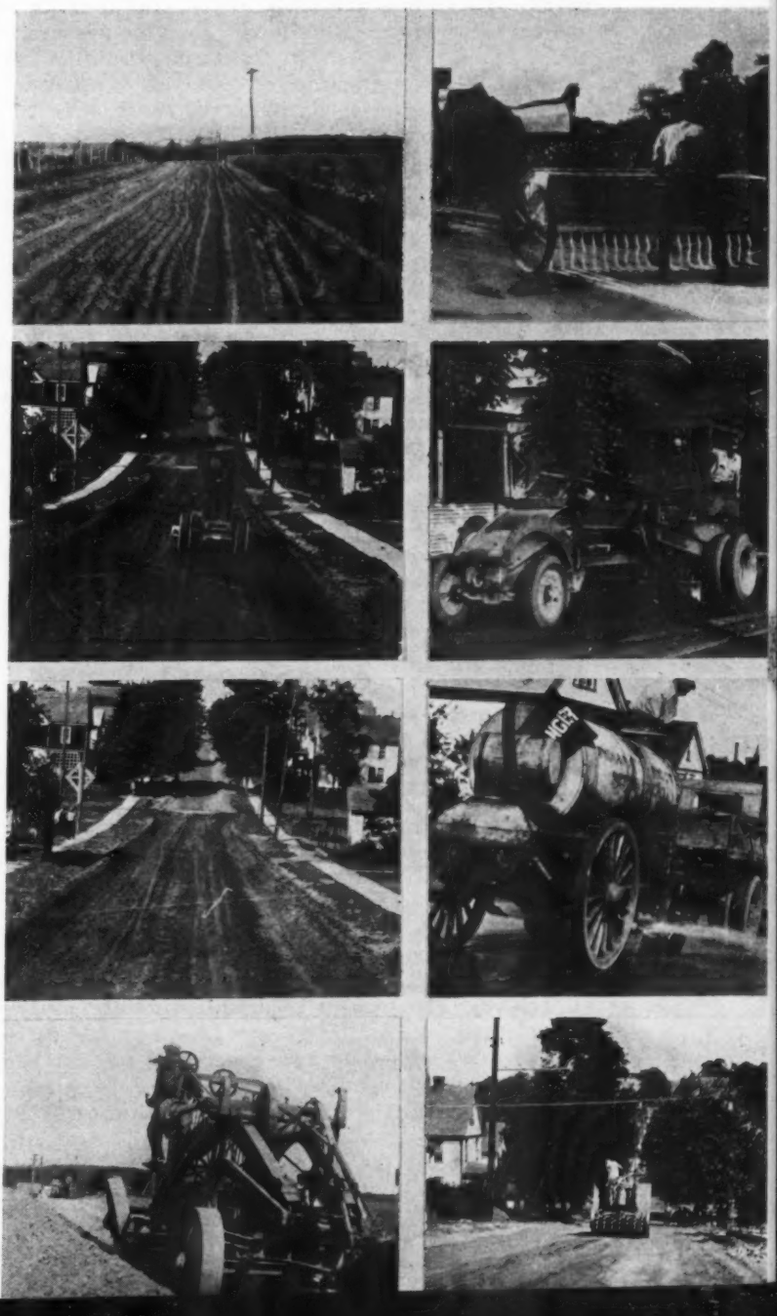
Agents Assisting in Stabilization

Due to their action under varying degrees of relative humidity, calcium chloride ($Ca\ Cl_2$) and sodium chloride (Na Cl) are sometimes used in soil road stabilization.

The action of these two materials are somewhat different. The calcium chloride aids in preserving the moisture content necessary to preserve the bond and to lay the dust, preventing the dissipation of the soil fines or the binding medium through the action of the winds or traffic.

Sodium chloride seems to crystallize and form a bond

Steps in building a stabilized road shown by construction views: Left, top, scarified road, and in order down, windrowing, windrowing completed, and mixing: right, top to bottom, spreading chemical, spreading stabilized mix, sprinkling and rolling.



between the soil-mortar particles thereby tending to solidify and form a solid material.

When it is desired to use either of these salts the following procedure may be followed:—

Calcium Chloride.—When *mixed integrally* the calcium chloride should be applied uniformly to the partially mixed materials and incorporated with the stabilized material during the completion of the mixing operations.

When *surface application* of calcium chloride is specified, it should be applied uniformly in the designated quantity, by means of a spreader to the wetted surface of the stabilized roadway which has been shaped and compacted to the required grade and cross-section.

The first method will be found useful in the dry summer months, the second in the fall months. No calcium chloride should be placed during the wet winter months as it will only aggravate the wet condition.

Sodium Choride (Rock Salt).—When *mixed integrally* the sodium chloride should be applied in the manner similar to that of calcium chloride.

When the sodium choride is placed in a *single layer* the procedure will be as follows: When the spreading and compacting operation of the course in which the sodium chloride is to be placed is fifty per cent completed, the surface should be wetted and a layer of sodium chloride spread uniformly over the mixture in place at the rate per square yard and width desired. Excepting, however, that in the two-course construction the sodium chloride should be spread between the bottom and top courses.

Patrol Maintenance

After you have constructed the job don't think you can leave and forget about it—you can't. It is now entering the critical period of its life, what you might please to call the curing and compacting interval. During which time for a period of six to eight weeks it will be necessary to patrol the surface periodically (the frequency of the patrol depending on the volume and speed of traffic), and keep it shaped up while it is being compacted under the action of traffic. The rolling operation during construction gives the initial compaction but traffic and the elements finish the job. This patrol may be in the nature of shaping up with a blade grader, a drag or placing occasional patches or possibly a combination of these operations. Incidentally in patching use the same material that was originally used in the surface and for this purpose it is desirable to make up and stock a supply of the stabilized mix at the time of construction.

General Notes

Plasticity.—The plasticity index of the stabilized mixture should be as follows:—

One course construction and *top course* of two course construction ..... 3 to 12

Bottom course construction and *subgrade* construction ..... 0 to 12

The trend should be toward the lower rather than the higher plasticity index especially in the base courses. High plasticity leads to high capillarity and surface slipperiness. A low plasticity combined with proper gradation of the material will correct this.

Liquid Limit.—The liquid limit should not exceed thirty-five. The present tendency is toward a lower liquid limit.

Cross Section.—You have noted that the stabilized surface course is feathered out at the edges or rather that the shoulders are built of stabilized material and feathered. This cross-section is desirable in more ways than one, among these it eliminates the ditch or trench construction with its possibility of entrapped water, simplifies construction, and simplifies maintenance.

Drainage.—Remember this is a surface course and the construction of a road of this type requires just as close attention to drainage detail as other road types.

In this article the writer has tried to give you a brief resume of the set-up and procedure to follow in the construction of stabilized soil roads. For those who wish to go into the details of the problem the following references will be found helpful:—

"Engineering Properties of Soil" a book by C. A. Hogentogler;

"Public Roads" the official publication of the United States Bureau of Public Roads.

"Proceedings" of the Highway Research Board;

"Proceedings" of the leading Technical Societies; and these and other current technical and semi-technical publications for new developments which are occuring daily.

A statement was made at the beginning of this article —"At present we are not in a position to predict the future of this youngster of the highway field, etc." You can aid in its development—think it over.

Liability for Diverting Water in Highway Construction

In an action against a construction company for damages to plaintiff's real estate by the diversion of water resulting from the construction of a highway, the defense was, in addition to a general denial, that the defendant sublet the contract to another corporation, which was an independent contractor, for whose actions defendant was not responsible.

In order to construct the highway it was necessary to remove a ledge of rock about 30 feet high. There was evidence that many tons of rock blasted from the bluff were thrown into the river adjoining the right of way, forming a new channel and washing away a considerable portion of plaintiff's land.

The Kentucky Court of Appeals, H. H. Miller Construction Co. v. Collins, 108 S. W. 663, summarized the law in Kentucky governing the liability of the contractor in a case of this kind as follows: A contractor constructing a highway without negligence under the plans of the Highway Commission is not liable for damages resulting from the obstruction of the stream on the right of way, but he is liable for negligence in the performance of the contract or without negligence where the material blasted in the work of construction is cast beyond the right of way. Combs v. Codell Const. Co., 244 Ky. 772, 52 S. W. (2d.) 719. Under this rule plaintiff was not liable if its subcontractor was an independent contractor.

There was evidence that plaintiff, finding it had to either buy some new machinery or sublet a part of the work, sublet the grade and drain end of it. Its subcontractor agreed to construct the road according to the highway engineer's orders and specifications. After the work was sublet, plaintiff had nothing to do with it, except to pay the estimates each month. The subcontractor bought its own machinery and hired and fired its own men. The court applied the rule that if a contractor furnishes his own assistants, and executes the work either entirely according to his own ideas, or in accordance with plans previously given to him by the person for whom the work is being done, without being subject to the orders of the latter in respect to the details of the work, he will be regarded as an independent contractor. This rule is not confined to the original contractor, but applies also to a subcontractor. It was held the subcontractor here was an independent contractor and judgment against the plaintiff was reversed for a new trial.

Financing Twin City Sewerage System

Discussion of the equity and methods of financing the Minneapolis-St. Paul sewerage and sewage treatment by levying sewer rental charges

THE Minneapolis-St. Paul Sanitary District, organized in November, 1933, began construction of intercepting sewers in July, 1934, and of the treatment plant in September, 1935, and expects to complete the construction in May, 1938. Of these, the works used exclusively by Minneapolis are estimated to cost $3,240,000, those exclusively by St. Paul $2,350,000, and those used in common are estimated at $6,315,000 for intercepting sewers and $3,375,000 for treatment works.

The act under which the cities are carrying out this work provides means of financing it by tax levy or by levying and collecting sewer rental charges, and the officials of both cities are attempting to decide which method to use. The city of St. Paul, for the year 1938, has placed both the amortization and the operation and maintenance charges entirely on the tax levy, but this may be changed in coming years should it desire. Minneapolis has placed on the tax rolls a levy for 1938 of 1.65 mills to defray the city's share of the construction costs, and the sewer committee has recommended to council what the city's share of operation and maintenance costs of the sewer and treatment plant for such time as it may operate in 1938 be covered by a sewer rental charge calculated as a percentage surcharge of the actual water bill. Indications are that this surcharge will be approximately 20% of the water bill, that for domestic meters being based on readings during the winter quarter only, thus eliminating charge for summer sprinkling water, which does not reach the sewer.

Concerning the equity and methods of levying sewer rental charges, the following discussion is presented in "Minnesota Municipalities":

It may be considered unfair by some to charge to the present users of the system the entire cost of such items as interest and amortization of bonds, issued for the construction of a system which may be used for a long period in the future and for which allowance is made in the design to care for the sewage from properties at present undeveloped but which nevertheless share in the general benefits accruing to all properties because of the construction and operation of the collection and treatment works. For example, the main intercepting sewer built by the Sanitary District will be completely paid for before its capacity will be reached, while its useful life will continue for a still longer period in the future. Some municipalities limit their charges to include only operation, maintenance and repair, while others include interest and retirements or fixed charges.

A sewerage system is a benefit to the health of the whole community. Therefore, some proportion of its cost should be paid for by general taxation. The owner of land receives a particular benefit if a sewer is laid by his land. Therefore, he should pay an assessment for this special benefit. If the cost of building this sewer is a special benefit, keeping the sewer in condition for use is a further benefit to those who use it. Hence, a sewer rental charge is just and equitable.

In studying the various methods used as a basis for levying sewer rental charges, we find eighteen methods in use. Half of the methods are based partly or entirely upon the amount of water used, whereas the second half are based upon factors independent of the actual amount of water consumed.

The rental may be intended to defray operation and maintenance charges only or to cover all or a portion of the fixed charges as well. Since a general benefit accrues to the entire community, it is argued by some that a portion at least of the total annual charge should be paid by the municipality as a whole, while others believe that the total annual charges of sewerage systems and treatment works should be borne by those using the system.

Most authorities agree that water consumption, with allowance in certain instances for water not returned to the sanitary sewers, is a reasonably accurate measure of the use made of the sewer system, and such authorities are in accord that the amount of water used should be, where practicable, taken into consideration wherever sewer rental charges are made.

A very important consideration which has particular reference to the Twin City situation is whether sewer rentals, if made, should or should not cover fixed charges, which in this project will constitute a substantial portion of the total annual charges (approximately 50 per cent). While it is possible to make sewer rental high enough to cover the total annual charges, it should be noted that both the sewers and the treatment works will probably greatly outlive the needs of present users, and since they constitute a general property benefit, the fixed charges should, many believe, be paid in large part by a general property tax.

Because a general benefit accrues to a municipality and its inhabitants due to the sewerage and sewage treatment facilities provided, regardless of whether or not they have connections to the system, a method of levying charges based solely on the water consumption is considered by some as unfair to the present users of the system, especially so if fixed charges on construction are included. They reason in the case of operation and maintenance charges that the general community benefits from having collection and treatment facilities; and in the case of fixed charges, that the works provided will still be serviceable and in use after some of the present unsewered areas are served, which property, on the basis of metered water consumption only, would not pay its just proportion of the cost of providing sewerage and treatment facilities.

There will be certain administrative problems to be met in the proper application of any method involving measurements of the water used. In both the private home and in a business or industrial establishment, all water used is not returned to the sewers. In the case of the private home, a charge based on the summer consumption of water would not, in many instances, be a correct measure of the service rendered, since a large portion of the water supplied is then used in sprinkling and is not returned directly to the sewers. For this reason it would be desirable, if economically practical, to meter or measure the sewage flow and use that, instead of water consumption, in fixing rates for sewerage serv-

ice. For certain practical and economic reasons, however, the actual metering of small quantities of sewage is not a feasible undertaking. On the other hand, the winter consumption is not a true measurement of benefits because the water consumption then is, on the average, at a lower rate than the summer consumption, exclusive of that used for sprinkling, because of the increased use during the summer for bathing, washing and general wastage, all of which is, however, returned to the sewers. Only by the installation of separate meters for lawn sprinkling services could an accurate measure of the water used for sprinkling be obtained. In most cases the cost of such an installation would not be justified. In the case of industrial use of public water supplies, not all of the water used, especially so in certain industries, is returned to the sewers, for which allowance should be made in computing rental charges.

A few public services are still unmetered and some industries have their own private source of supply. In these cases, meters would have to be installed or an agreement made with the officials concerned as to a proper charge. There are 242 known private supplies in Minneapolis and 145 in St. Paul, which would either have to be metered or investigated from time to time to determine the quantity of water being used and the proportion returned to the sewers.

Where the public water supply is furnished by private companies and the records are inaccessible, it is sometimes impracticable to use water consumption as a basis of determining sewer rental charges.

In application, the surcharges would be added to the water bills on the following basis:

(a) For domestic consumers of the public water supply, the surcharge would be based on the water bills for the winter quarter but would be billed quarterly as are the water bills.

(b) For commercial consumers of the public water supply, the surcharge would be based on the month to month water bills, billed monthly.

(c) For private water supply consumers the surcharge would be based on the measured water consumption at rates similar to the charges made for water purchased from the water departments.

The charges under (b) and (c) may be altered to take into consideration the character of the sewage or wastes, i.e., whether strong or weak. Furthermore, it may be considered equitable to assess a service charge against consumers of private well supplies to compensate for added inspection and meter reading costs, since such extra costs would not be entailed by the city for public water supply consumers.

The cost of operation of the plant will necessarily vary greatly due to the use in some years of large amounts of chemicals and none in others. So the charge, if finally based on a percentage of the water bill, will vary from year to year. The cost of the first year's operation of the treatment plant will require a surcharge on the water bill of approximately 20 per cent while the interest and amortization of bonds will require approximately 15 per cent in addition.

Hot Water Ice for a Skating Pond

Adjacent to one of the school buildings of Glencoe, Minn., is a public skating pond of about a half-block area. This was heavily patronized and quickly cut up, and for smoothing the surface, water was flooded over it to freeze. This was done by using a dripping pipe about 15 ft. long, connected to the school building by a ¾" hose, which is drawn across the ice. Flooding with cold water often produces a thin skimming of ice that shells off; but hot water was used in this case, which slightly melted the rough ice and fused with it, leaving a fine, smooth surface which did not shell off.

City Not Liable for Damage Caused by Unusual Storm

In an action for damage caused by the flooding of plaintiff's building and injury to his goods and property therein against the city of Montevideo, the Minnesota Supreme Court holds (Hanson v. City of Montevideo, 249 N. W. 46) that where the evidence established that the city was not negligent in the improvement of its streets nor in the construction and maintenance of the drainage system therein, and also that the storm which caused the damage was an unusual and extraordinary one which could not reasonably have been anticipated, judgment for the city notwithstanding a verdict for the plaintiff was proper.

Liability for Diverting Rainwater by Street Grading

In an action by a landowner alleging injury to his land by flooding caused by the change of the natural course of rainwater by the construction of a street and highway, the jury found that the construction of the highway and the grading of the street "diverted the water in the locality in question from its natural course," but also found that such diversion had not caused any damage to plaintiff's property. The Texas Court of Civil Appeals, Sweatt v. Tarrant County, et al., 108 S. W. (2d.) 700, found the evidence conflicting, and held that the question of ascertaining whether any diverted water injured plaintiff's land was for the jury. Judgment for defendants was affirmed.

"Acceptance" of Public Work

In an action by a subcontractor, who had assumed the obligations of a contractor for the construction of a highway for the state of Montana, against the contractor and his surety, the vital question was whether there had been an acceptance of the work more than fifteen days before the plaintiff's claims were filed within the meaning of the statute. The defendant claimed that acceptance by the highway commission's engineer constituted an acceptance within the statute. The Montana Supreme Court, Kirkpatrick v. Aetna Casualty & Surety Co., 65 Pac. (2d.) 1169, reviewed many cases from other jurisdictions holding the word "acceptance," as used in such statutes barring claims on public works contractors' bonds if not filed within a specified time after acceptance by the public body concerned, contemplates a final, complete and unconditional acceptance. Under the Montana statute acceptance is required by "affirmative action of board, council, commission, trustees, officer or body acting for the state." The court held that the custom and practice of the state highway commission to rely upon the acceptance of its engineer could not override the positive mandate of the statute requiring affirmative action of the commission, except as it might serve to preclude it from questioning the conclusion of the engineer as between the state and the contractor. The plaintiff's claim was held not barred by the expiration of fifteen days after acceptance by the commission's engineer. Only acceptance by the commission itself could start the running of the statute. Judgment for plaintiff was affirmed.

Courtesy Ingersoll-Rand

Trenching for sewer construction in Wilkes-Barre, Pa., at left: winter work at Lake George, N. Y., at right

Many Uses for Air Tools in Construction and Maintenance

Public Works presents herewith a series of articles by its readers outlining the many uses of air operated tools. So general has the use of air tools become on construction that there are few jobs of any magnitude on which air is not available. The many uses and economies of similar equipment in the everyday routine of city and county maintenance and construction, including water department work, have not generally been recognized. Data presented herewith represent experiences typical of such work.

In Water Works Plants

H. F. Blomquist, Supt., City Water Works, Cedar Rapids, Iowa

ENGINEERS can calculate fairly accurately the difference in cost of doing construction work with one type of equipment as against another. There are situations, however, both in construction and maintenance, when the apparent job cost differences should not determine the way in which a job should be done. This is especially true in water works maintenance. When an emergency arises that affects water service in any way, the method which will restore service in the shortest possible time should be adopted. Water works operators soon learn that a consumer's evaluation of water service is very different when it is interrupted by a break in a main or other trouble, than when he pays a water bill that is a little higher than the previous one.

The actual value of public water service is always many times more than it costs. Perhaps because a good water supply is furnished at so very low cost, when compared to the many other necessities, the consumer is prone to value it accordingly until something happens that causes interruption in this twenty-four hour service. Those responsible for maintaining public water service must, therefore, ignore its cost, and instead, consider the inconvenience to water users and other hazards involved if it should be interrupted. They should aim to do everything both in the original planning and construction, and afterwards in its maintenance so as to always be a lap or two ahead of possible trouble. They must not forget that although large pipe breakages in water systems are comparatively few, yet in the hundreds of miles of mains in a fair size community, breakage may, and sometimes does occur. Therefore, every water works should be organized and prepared to swing instantly into action should the emergency arise. First, the section of pipe system in which the break occurs must be shut off. Here a safe and reliable power device for turning valves may save valuable time.

If the expense of maintaining a complete line of suitable materials, tools and equipment for immediate use in cases of emergency is ever justified, it is in water works operation and maintenance. The value of water service and not its cost should again be remembered here. Fortunately, the tools and machinery needed for even the best equipped water works maintenance organization are not excessively costly, and are within reach of the many smaller communities also. Besides, where the main extensions and other types of construction are done by the water works' own organization, most of the equipment serves a dual purpose and is, therefore, doubly justified.

Of the larger pieces of equipment added to the primary construction and maintenance tools, the portable air compressor has come to fill a variety of uses. From the original function of supplying compressed air for air driven rock drills, the portable air compressor has now become the means of transmitting power to many types of tools useful in water works construction. The paving breaker was primarily developed for

cutting pavements for trenching, but with adaptable tools from steel points to various types of cutters, it has become a universal tool in pipe trenching. We have found it useful not only for cutting pavements, but for breaking frost, concrete, rock, digging shale or hard clays, driving trench sheeting, and with a proper tool it makes an excellent heavy duty tamper for critical places where thorough packing of the ground is necessary. Smaller and lighter air driven tools that are also useful in water works construction and maintenance, are the air hammer, trench tamper, air hoist and air motor, all of which are adaptable for many uses. The air hammer is used mostly for caulking the larger pipe joints, but can also be used for cutting and riveting. The air hoist has found several different uses in our work. Fastened to an ordinary boom crane it is very convenient for unloading pipe from cars in the storage yard. Mounted on a skid it is often used for back filling trenches. It has also been used for lifting pipes in place on pipe line construction.

Other types of equipment that should always be ready for use include trench pumps of various capacities, and a portable lighting system. We have found a 1,200 watt, 110 volt gasoline driven electric generator very useful for light at night and for furnishing power for small electric tools such as drills, grinders, wire brushes, etc.

The equipment described above are all available at costs that the average smaller water department can afford to pay, and should be a part of its equipment. For larger cities the construction equipment will include other larger pieces, such as large trenching machinery, traveling hoists, back fillers, and various other material handling machinery economical for doing work on larger scales. While the larger equipment is not recommended as necessities for the average size water works construction organization, and may not be economical investment for such, it should be remembered that the maximum amount of investment in useful equipment that is economical for any water works is often much higher than we, as water works men, estimate. No water works can afford to jeopardize good continuous service for savings in the investment of necessary tools and equipment that will save time in overcoming emergencies and affect economy in construction and operation.

With the advantage gained by having useful mechanical tools and equipment goes the responsibility of always keeping them in good working order. Carelessness with tools and machinery is very costly. A tool or machine is of no value for emergency use unless it is ready to operate. After being used on a job, all mechanical equipment should be cleaned and inspected, oiled when this is advantageous, and repaired if not in good condition, and then returned to their respective places. Orderliness and system in storing tools and materials may save much valuable time in emergencies.

In all their activities, water works men should have uppermost in mind that they are not dealing in a common commodity, but are the guardians of the health and properties of all their neighbors within the limits of the territory served by their water systems.

In a Village Water Department

Charles W. Heidt, Jr., Superintendent of Water Works, Liberty, N. Y.

Mr. Heidt

THERE are many uses in the Water Department for a compressor, but the greatest value to us lies in the time saved in reaching leaks. We have an unusually high pressure in our water lines, and this, combined with the heavy truck traffic on Route 17, the main highway through Liberty, causes many small breaks every year. At least 90% of these occur under brick or concrete pavements, and our compressor enables us to break through and be started toward the leak in 1½ hours. Without the compressor, it ordinarily takes 4 or 5 hours to break through.

The Department owns a 120-cu. ft. compressor which is mounted on a discarded Packard fire truck, we have two demolition tools and one drill. The upkeep of this equipment is very small; it will operate 8 hours on 12 gallons of gasoline.

At the present time we are laying a 10-inch cast iron line on North Main St. which takes us through brick and macadam surfacing. On this job we have struck 60 feet of solid rock, but with the drill working, we have lost very little time, the work progressing at about usual speed. In the macadam cover and 15 inches of frost, one hammer will break a strip 2 ft. wide and 36 ft. long in one hour. In removing brick, very few are spoiled, when the air tools are used, and about the same rate of opening trench is possible as in macadam.

Last fall we laid a 10-inch line under a double track railroad. In digging under the rails, we struck several large boulders, but despite these, the air equipment permitted us to finish the crossing in 1½ days.

On the Mill St. extension, where 1,550 ft. of 6-inch cast iron pipe were laid, 200 ft. were in solid rock, and 1,000 ft. through a concrete pavement. On this job, the compressor was used 180 hours. On this job, one hammer averaged 18 ft. of 18-inch wide cut per hour through concrete 6 inches thick.

The compressor equipment has been used by other departments of the village and has also been rented out, thereby producing some income to the village. On a large sewer job constructed by force account by the village, the compressor was used for 368 hours, much rock being encountered. The odd jobs for which the air equipment has been rented (at $3 per hour) include breaking out the concrete vault of the old post office, 9 ft. by 10 ft., and 2 ft. thick, which required 32 hours of work; and the chiseling out of a cellar in solid red rock. This cellar was 24 ft. by 26 ft., and was cut into the rock 4 ft. The cost to the owner for the air equipment was $160.

In a Large Water Department

S. H. Taylor, Supt., Water Department, New Bedford, Mass.

MANY years ago this department purchased an air compressor. As compared with those of the present time, it was a very clumsy and antiquated affair, mounted on wheels and towed from job to job as needed.

As a result of wear and obsolescence, this has been replaced from time to time by more modern outfits until we now have a 1936 model compressor of 160 cu. ft. capacity mounted on a truck chassis with a complete outfit of hose, tools, etc., for practically every purpose. For convenience the hose is on reels permanently mounted between the compressor and cab and the tools are in locked compartments on the chassis alongside the compressor. We now consider it an essential part of our equipment and its use has resulted in great saving of time, labor and cost in our work.

We use it for breaking street pavement for trenching, cutting holes through stone and concrete building foundations for installing services; for drilling ledge and large boulders encountered in trench work. It is indispensable for trenching in frozen ground. It is also very useful in tamping the backfill in trenches. We also use an air driven spade which helps materially in excavating clay and other difficult material in trenches.

We maintain about four miles of standard gage railroad, connecting our pumping station with the main line of the N. Y., N. H. & H. R. R. and find

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the compressor very useful in tamping railroad ties which have to be replaced from time to time.

We also use it for operating boring machines and other wood and metal working tools on the larger jobs.

We find it much more convenient to have the compressor mounted on its own chassis than the old method of towing it.

Cities Employ Air Tools for a Variety of Jobs

J. B. Jewell, Supt., Dept. of Public Works, Pontiac, Mich.

THE Department of Public Works of Pontiac, Michigan, has at present two portable air compressors which are used on maintenance work and various construction projects. One of them is mounted on a Model T Ford chassis, operates at 815 revolutions per minute and displaces 120 cubic feet of air per minute; the other one, purchased in 1936 and mounted on a G. M. C. truck chassis, operates at 1300 revolutions per minute and produces 105 cu. ft. of air per minute. Both are driven by gasoline motor.

Concrete breakers, air spades, tampers, and sheeting hammers have been quite extensively used on both new construction and repair work. Wherever it has become necessary to cut through existing pavements, the concrete breaker has done the work, the trenches excavated by air spade whenever the soil was suitable for the use of that tool, and the backfill compacted by air driven tamps.

During the past three years, Pontiac has had a number of CWA, FERA and WPA projects in operation. These projects have consisted quite largely of sewer and drain construction, and have been carried on throughout the winter months when the ground has been frozen to a depth varying from 1 to 2½ feet. Both compressors have been in practically continuous service breaking frost for the trenches. It was found that the ordinary point used in breaking concrete would operate much more efficiently in frost if sharpened in the shape of a chisel about 2½ inches in width. Both compressors are now occupied in this type of work and are shown in the accompanying photographs.

Soil conditions in the vicinity of Pontiac are such that the construction of a sewer of any depth requires the use of tight sheeting. Two-inch plank in 12, 14 and 16-foot lengths has been used for this purpose. Driving by hand with sledges quickly broke up and destroyed the sheeting, but driving with an air operated sheeting hammer increased

Above, working on a grading project in Pontiac; below, breaking frost on a storm drain job.

progress and reduced breakage to a minimum.

On several sewer projects, it became necessary to use sand points to control the ground water and dry up the trench so that pipe could be properly laid. These sand points were made up of ordinary well points connected to an iron pipe approximately 10 feet long and then attached to a 6-inch manifold by means of a short length of hose. Driving the points into position with sledges was out of the question due to the damage it would do to the pipe and point. A section of half inch pipe was attached to the air hose and the open end rounded off and reduced to about one quarter inch. This was used to jet the points into place easily, quickly, and without damage.

Some idea of the extent to which the city has made use of compressed air may be gathered from the fact that on WPA projects alone, during the year of 1937, they were operated a total of over 800 machine hours. A comparable number of hours of operation has been spent on routine maintenance work. In addition to the above work, there have been frequent calls from private individuals and companies for the use of a compressor for a few hours or days. A little revenue is realized from this rental service.

The above use of compressed air is by no means original nor unusual, but one problem was encountered within the past year, the solving of which was simplified by a fairly recent development in air compressor design. A short explanation may be of some interest.

Pontiac's garbage is disposed of by means of an incinerator of 70 tons capacity. The garbage is dumped onto a charging floor and reaches the furnaces through seven hoppers or chambers. These chambers are opened and closed by means of a slide operated from a piston driven by compressed air, furnished by a stationary water cooled compressor, driven by an electric motor and pumping air into a storage tank at 110 to 120 pounds pressure. The furnaces receive their draft from a 150 foot chimney and a fan driving air through a preheater and over the grates. A current of air is thereby maintained throughout the plant, keeping it colder than the outside air. Trouble developed every winter in freezing of the water system, particularly that part of the system serving to cool the air compressor, which froze several times, with a resulting high expense in repairs. The trouble was eliminated by replacing the water cooled machine with an air cooled, two stage compressor of 105 cu. ft. per minute capacity driven by the same electric motor and pumping into the same storage tank. During the change, service was maintained by connecting one of the portable compressors into the storage tank.

A small compressor, of the type generally used in garages, furnishes air for the inflation of tires, cleaning of equipment, operating a spray gun for repainting equipment, and general garage work, and plays a very important part in the maintenance of all city equipment.

In Port Jervis, New York

By Fred Conrad,
City Engineer, Port Jervis, N. Y.

IF ever a construction tool had to prove its worth, the portable air compressor had to do so during the period of so-called depression here in Port Jervis. Anyone in the public works field from 1932 on must be familiar with the fact that one of the fundamental ideas back of all "made work" programs, was the substitution of the natural mechanical processes usually employed with those of the most primitive manual operations. In the early stages of the temporary emergency relief administration and other such agencies it was no unusual sight to see a steam shovel dig into an embankment and

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The Park Avenue cut, left, and a close-up of the job, at the right

dump the contents of the bucket on the ground where it was rehandled by shovel and loaded into trucks. Similar ideas prevailed against the use of air compressors and other mechanical methods of accomplishing construction work.

Let it be understood that this is not a criticism of any particular method or idea as put forth by the relief agencies, but rather the preliminary to the case history of a piece of machinery that proved itself so necessary that it overcame one of the fundamental ideas of the men back of the relief work program.

One of the first large projects started in Port Jervis under TERA was the construction of Park Avenue, a three-lane concrete drive carrying the traffic of a national highway through a portion of the city. Although it would have been possible to pave the existing streets carrying the traffic in question, it was decided that in order to provide a real work program, and in addition provide an entrance of beauty to the city and one with scenic qualities, a thirty foot highway in the nature of a by-pass would be constructed along the slope of a mountain. After the necessary surveys and the designing had been completed it was found that about 30,000 cu. ft. of rock excavation would be involved, one cut having a depth of 45 feet. Strange as it may seem, no objection was raised to the large amount of rock work. It was thought that with hand drilling it would provide work for a great many men.

As soon as the work started it became evident that something was wrong. While it was true that many men were kept busy drilling it was also found that very little excavated material was moving. In fact so little material was moving that it would have taken a period of years to do the excavating alone. When the facts in the case became plain to everyone, two portable 220-ft. compressors were rushed on the job to operate the air drills and jack hammers. With the use of these machines it was found that just as many men could be used on the job loading the trucks, and that a great deal more material was being moved. Pictured herein are some of the machines at work, and some of the holes ready for shooting. It should be remembered that deep holes were necessary to make a dent in the excavation. Ten and twelve foot holes were ordinary and this with hand drilling would have been out of the question.

Mr. Conrad

When Park Avenue was started it was generally thought that it would be the only job we would have to do in order to provide work for those on relief. We along with the rest of the country were wrong and instead of being both start and finish, we found that it was only a feeble start. Many larger projects have been started and completed since that time and most of them have required the use of air compressors. We now have, in addition to the original 220-ft. machines, an additional two 440-ft. ones.

Air compressors have many uses but in rock excavation they serve their greatest purpose. Early in our WPA experience it was found that our relief load was greatest during the winter months. This inversely is the period least suited to open air construction work. Excavation work, however, particularly in rock, can be done just as easily in the winter months. When you have a solid mountain of rock in your back yard, as we have in Port Jervis, it is no trouble at all to provide good winter work.

One of our finest pieces of work has been the regrading and realignment of Elks Park, a city owned park of some 300 acres. This is laid out on the mountain mentioned before and in the park is a scenic road, Skyline Drive. This drive had never been properly designed as to grades and alignment, but just "grew." It had many hairpin turns and grades that even the present high-powered automobiles had difficulty in negotiating. The City Engineer's office was called on to reconstruct this drive in such a manner that elderly ladies of both sexes could and would drive it without having heart failure. To do this required large quantities of excavation, some of the cuts reaching thirty feet in depth. Again our compressors were called into action, not only to do this work in a reasonable length of time, but to provide the loaders with sufficient material to keep busy.

When you have a rock mountain in your back yard it is often found that said mountain has extended its feet under your city also. Much storm and sanitary sewer work has been done during the last six years and this has called for the ever faithful compressor. With a little diligence in placing and shooting dynamite, it was found that we could operate almost anywhere in the city. Where use of dynamite was out of the question, a jack hammer and pavement breakers were found to be quite useful. One of the many uses we

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put on our jack hammers was the breaking out of frozen surfaces. As stated before, a great deal of our relief work is done in the winter time. We find that it takes the backbreaking part of trench excavation out of the job if we precede the digging gangs with jack hammers and bull point and break up the frozen top part of the trench. This applies of course to black top pavements. In digging through concrete and brick pavements the use of pavement breakers is essential. It has been our policy to keep cuts in hard pavements down to a minimum but where it has to be done, we find that the cut can be prepared for patching more quickly and result in a neater and better job when plenty of air tools are available.

The mention of air tools naturally brings up the point of tools for polishing and finishing concrete surfaces. A great deal of concrete retaining wall and other exposed concrete work has been done, requiring removal of form marks, bulges or other defects. We have found also that special effects can be secured in concrete by the use of air operated working tools.

Using compressor and air tools in McPherson County, Kans.

I could go on indefinitely giving instances where we have found compressors not only handy but indispensable. Suffice it to say that while our relief work program has been greatly cut down, we still find use for our compressors regularly. When we are not using them we find it profitable to rent them to local contractors, neighboring villages and townships.

Air Tools Valuable in County Highway Work

Guy Hall, County Engineer, McPherson, Kansas

Mr. Hall

MY experience with air compressor equipment has been confined principally to rock drilling for rock surfacing on our county highways. In some of our adjoining counties field rock has been used for surfacing. This field rock is usually about the size that can be crushed without further work, or is soft enough to break up with a sledge to a size the crusher will take. I have not favored using this class of material as it is too soft, and we have a hard ledge rock that is very satisfactory. In working up this rock we contracted our drilling at first but later bought our own outfit. From our experience, I greatly favor the county owning its own equipment, not only compressors, but for all kinds of work.

I spent quite a little time investigating the rock I proposed to use for surfacing and finally decided on a very hard sandstone. This is almost quartzite and has a hardness of ten to eleven, practically as hard as a loan shark's heart. As might be judged from the hardness, it is hard to drill and hard on crusher jaws, due to its abrasiveness. We tried regular steel jaws on our crusher at first but got nowhere with them so had to change to manganese and they do not last too long. Naturally this material is fairly hard on drill steel but, so far, our costs have been moderate.

When we started about five years ago we were new at the work and did not want to buy too much equipment so we made contracts with different drillers to take care of our work. At first the price was $1.25 per hour, the driller to furnish everything and we used him about half time but the different outfits we hired had other work and were not always available when we wanted them and the cost rose to $1.75 per hour so I decided it was about time to get our own outfit and do our own work.

Last year we bought our own equipment and we have been highly satisfied with the results. This outfit is portable, is mounted on wheels and drawn with a truck and consists of a 130-foot compressor with fifty feet of hose. It is often necessary to work more than fifty feet from the compressor so we have several lengths of iron pipe which gives any reasonable working distance desired.

Some engineers disagree with me in the matter of the county owning their own equipment and doing their own work but I have found it satisfactory in all cases I have tried. Some seem to think that a contractor can do our work better than we can but I do not see it that way. We can hire as good men as they can and we are fortunate in having good foremen. We can offer more nearly continuous work than the ordinary small contractor who would do county work. Our organization is at least as good and the workman has the opportunity to work all year which gives him a feeling of greater security as he does not need to worry about getting other work after the ordinary working season is over. Then there is the item of loyalty that should be considered both ways due to long time service. In turn, we can work to better advantage as we have our men when we want them and can use them on other work when we do not need them on the job for which they were hired.

In operating our own compressor we have another advantage. When we were hiring our driller we used him only for our necessary drilling in order to hold down our costs but we find there are many times when the rock was not shot into pieces that were really economical for our crusher to handle. We now drill a shallow hole in these larger pieces, load with probably a half stick of dynamite and break them up for less than could be done by hand or with a doby shot.

We drill about a one-inch hole which, of course, is smaller than the usual inch and a quarter stick of dynamite but we can get a lot more footage with the smaller hole and we always cut the stick and pour in loose dynamite which is tamped to fill the hole. We get better results this way than in drilling a larger hole and loading with full sized sticks and the consequent loss of power

due to the space between the dynamite and sides of the hole.

We buy our drill bit steel in long lengths and cut to suit ourselves, getting the short bits as the longer ones wear down. The dull bits are taken to town at night and left with our blacksmith who sharpens them, the driller taking out a fresh supply as needed from stock that has been sharpened ahead. We first tried the star shaped bit but had too much difficulty in getting them stuck in the hole with much unnecessary waste of time and profanity so tried the chisel method of sharpening and found that much better. The chisel end is pounded out somewhat larger than the shank of the bit and the hole thru the shank kept open so that a blast of air thru this hole keeps the hole clean.

We can drill about twelve feet of hole per hour with our outfit but it must be remembered that our rock is very hard and a much greater footage could be obtained with softer rock. The motor uses about ten gallons of tax-exempt fuel per eight hour day and nine quarts of oil on a sixty hour change. Our costs to date have not exceeded eighty-five cents per hour for operator, fuel, oil, bits and depreciation and repairs, of which there have been none to date. This is quite a saving over $1.75 per hour for contract work with the advantages mentioned in having our own equipment.

Naturally, there are numerous other uses for a compressor on county work but we have so far confined our use to the work described.

In San Joaquin County, California

E. K. Dupont, County Bridge Engr., Stockton, Calif.

SAN JOAQUIN COUNTY, Calif., Highway Maintenance Department maintains 765 miles of roads. Included in this work is the maintenance of some 250 bridges and 9 small gas operated ferry boats. The highway department paints all bridges, ferry and bridge-tenders' houses, railroad crossing signs on pavements, and also the center stripe on roads, of which there is about 200 miles done annually. In addition to this the department installs and maintains drain culverts ranging in sizes from 6″ to 48″ in diameter.

The Highway Maintenance Department works under the direction of J. B. Manthey, serving both as County Surveyor and as Maintenance Engineer. J. P. Spooner is deputy County Surveyor, having direct charge of survey crews and draughting room. J. Freitas has charge of road crews and equipment, with J. Beckwith as assistant. The machine shop foreman is C. A. Fitzgerald. Office work is under G. Marlette, as office manager, with three assistants. The writer is bridge engineer for the department.

In maintenance of both roads and bridges we use three air compressors, of various sizes. These machines, while differing in capacity, have two features in common. All machines are portable and all are gas engine operated.

The smallest machine, capacity unknown, is operated by a 1 hp. gas engine. The unit is mounted on a channel iron frame, and is used mostly for light spray painting jobs, such as interior painting of ferry and bridge-tenders' houses, and other light work of that nature.

The next machine, in point of size, is a 25-cubic foot compressor, which is also mounted with its gas engine as a unit and can be used either on a truck or as a shop machine. The chief uses for this machine are striping center line on pavements, spraying concrete and wood bridge rails, and tree trunks with cold water paint. It also takes the place of our large machine on paving

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Compressors used in San Joaquin County: unit above is for servicing trucks; below are 110 and 25-ft. units.

breaker and boring machine, when the large machine is in use.

The largest machine is rated at 110 cubic feet. This machine, with its engine, is mounted on a four-wheel trailer. Because of its larger capacity, it naturally fits into many more uses. With this machine we have sandblasted and painted approximately 50 steel bridges. It is used to repaint all the road equipment, operates a large paving breaker on road or bridge work, operates boring auger, and is rigged up to drive light sheet piling. We use this machine also to operate chipping hammer and riveting gun.

We have found that in using compressed air in painting, including the use of cold water paint, the results, both as to quality and quantity, well justify the initial expense. The maintenance cost of these machines has been very moderate.

In road and bridge work, cutting and tamping pavement, wrecking old concrete, and cutting hardpan for foundations, we have found that compressors are invaluable.

Beside the above, we have two small compressors, gas operated, for servicing trucks in the field.

In Broward County, Florida

H. C. Davis,
County Engineer, Ft. Lauderdale

A SINGLE stage, 100 cubic foot, portable air compressor has been for many years in almost daily use by the Broward County Road Department. For speed and convenience in reaching the several quarries located at widely separated locations, and other projects where it is required, this has been mounted on a 1½-ton truck chassis.

It is most frequently employed in drilling the soft limestone rock which is used for rock base on all county roads. This material, when placed on the sub-grade in a very finely divided condition and thoroughly waterbound and rolled, cements in a compact, almost impervious layer and requires only a wearing surface of asphaltic oil and sand or coarser cover material to make a very satisfactory pavement for secondary roads.

To avoid the expense of crushing, which, owing to the soft and sometimes sticky character of the material when first quarried, has been found both costly and unsatisfactory, the material is usually "shot fine" before excavating. This requires the drilling of holes spaced from 2½ to 4 feet in both directions, and the use of about one pound of explosive to the cubic yard. Holes vary from 6 to 12 feet in depth, depending of course, upon the height of the working face.

New construction in the farming districts nearly always consists of building a roadbed with material excavated from a borrow pit in the form of a ditch or canal parallelling the embankment. The usual formation encountered is from one to four feet of sand, marl or muck, underlaid by limestone rock

which in most cases is too hard to excavate without blasting. Borrow pits are made deep and narrow in order to obtain the greatest possible proportion of rock in the finished roadbed. The most desirable farming areas are usually overflowed from a few inches to more than a foot in depth during the summer months when the greater part of such road work is in progress.

Drills of the hammer type, weighing 60 lbs. are used both for quarry drilling and for blasting in the roadside ditches. Especially in the latter work, due to the water and soft surface soil, best results have been obtained by the use of drill rods consisting of plain 1¼-inch iron pipe. An ordinary, short, ⅞-inch round head rivet is inserted in the bottom of the pipe and the whole driven to the required depth. The charge of ⅞-inch explosive is then loaded into the pipe and held down with the tamping stick while the pipe is withdrawn.

The same method is used for the greater part of the quarry drilling, though in some of the quarries better results are obtained by the use of a square ended, solid drill rod. No local rock has yet been encountered hard enough to require the use of any type of sharpened drills.

Among the minor but important jobs upon which the compressor is used are repairs to steel bridges, construction and repair of dragline booms and other equipment, though in recent years electric welding is replacing riveting to a great extent on such work.

The county maintains and operates ten drawbridges across the Florida Intracoastal Canal and other waterways, and the compressor with rotary air drill is used for boring bolt holes in the frequent repairs necessary to the fender system and other timber portions of the substructures. Some of these fender wales are fastened below the water line, so that even where electric current is available the choice usually falls upon the compressor if it can be spared from other work.

Several years ago the U. S. Government acquired the Intracoastal Waterway and widened and deepened the channel, causing considerable damage to the concrete abutments of several of these bridges, most of which were constructed years before there was any idea of the waterway improvement. Due to the lack of sufficient funds to reconstruct or even permanently repair these weakened abutments, they have been temporarily anchored back to dead men buried in the approach fills. In this work the compressor and hammer drills were used to provide the many holes through the abutments to secure the anchor rods. The most effective tools used in this work were also home made, consisting of a short length of 1½-inch iron pipe, the cutting end of which was serrated around its entire circumference by means of a triangular file. The teeth thus formed, being about ¼ inch in depth, were flared slightly by driving onto the horn of an anvil to provide drilling clearance. After drilling about three feet of hole it was necessary to file new teeth, but this device was found to cut much faster than either star or chisel pointed drills.

The compressor and hammer drill, sometimes aided by a water jet, is used whenever it is necessary to drive sheet piling for small cofferdams in culvert construction, and does very satisfactory work driving 3″ by 6″, V-groove sheeting up to ten feet into any local material except solid rock.

During the past year the State Road Department borrowed this compressor and used it in connection with a home made sand blasting outfit to clean rust scale and old paint from one of their steel bridges in this county.

The portable air compressor with its auxiliary tools may perhaps not be the most important piece of equipment, but its holiday's have been few and far between and it has certainly earned its place on Broward County's payroll.

In Emergency Relief Work

Olney Borden, Supt. of Construction, Sullivan and Delaware Counties, N. Y., WPA

THE emergency relief work started in the majority of the rural areas with the inception of the CWA in November, 1933. The problem of finding work that could be done to advantage at that time of the year without any previous preparation was the first concern of those in charge of this work. The most logical winter work was the operation of stone crushing plants using quarry stone and putting in hammer broken stone base on town roads. Other work that could be done was the digging and laying of sewer lines and water lines.

A number of the sponsors of projects in this early period of relief work did not own air compressors. The traveling inspectors found men trying to pick frozen ground, drill holes for blasting quarry stone, and numerous other items of work by hand labor which should have been done with air compressors. The inspectors had to overlook the inefficiency of a great number of these projects because the sponsors did not own an air compressor. As the work has progressed, these inspectors have been

Mr. Borden

insisting that the sponsors of projects use air compressors wherever the nature of the work requires one.

There was a time not so many years ago that the majority of the towns and small villages did not own an air compressor of any kind. They figured that it was cheaper to rent one for the few times they felt they had to have one during the year. Now town and village officials realize that if they are to do any kind of winter work an air compressor is one of the most important items of their equipment.

In one county under my jurisdiction, there are seven work projects in operation employing 160 WPA workers. There is an air compressor on each one of these projects at all times. If any one of these compressors were to be out of order for two or more days and another one were not available, the project would have to be suspended until one could be made available. The work these compressors are required to do includes drilling rock for blasting, either in quarries or large rock in ditches; loosening frozen ground for opening sewer trenches; breaking pavement; cutting off the frozen overhang in gravel pits, and numerous other items of work. Any one of these items of work cannot be done with any degree of efficiency by hand work.

A recent interview with the man who operates a small air compressor outfit for a rural town shows the increase in use of this item of equipment. This man said that as recently as three years ago, he had work with the compressor

91 helpful booklets and catalogs are described on pages 59-62. Look them over.

only about four months of the year, usually during May and June, and again in September and October. During this past year he said he had used the compressor every month of the year. His job has been changed from a seasonal one to a year round one. He also said that he had to make a number of improvements on his outfit so that it could be used during winter weather.

Through the experience of the past two or three years, the small towns and villages have learned the value of owning a serviceable air compressor, and most of them will not be content with antiquated or second-hand outfits.

Barricading Roads Under Construction

Where a highway is under construction, and is not an accepted, completed highway, open to the public, a member of the public who uses it, with notice or knowledge that it is under construction, is bound to anticipate that at some near point in his progress the usable portion will end and the portion actually under construction and unfit for use will begin. He cannot go on under the assumption that the way is open and clear throughout. He is put upon guard and under the obligation of vigilant caution to keep a constant lookout for the end of the used portion and the beginning of that not open for travel.

No case has apparently been found which lays down a specific rule as to the character of lookout required of a driver upon a road under construction. But the above appears to have been the rule since the construction of modern improved highways began. It is similar in principle, though not precisely parallel in application, to that in respect to repairs being made in an already finished highway, but which is known to be undergoing repairs.

The Mississippi Supreme Court applied this rule in an action against the contractors for the construction of a concrete highway for the death of a motorist who, in daylight, ran into a 3-ton steel trailer drawn across the road at the end of the usable portion as a substitute for the usual painted wooden barricade. This wooden barricade, moved forward as the work progressed, had often been removed or broken down at night by unknown parties, and the green concrete damaged by vehicles using the unusable portion of the work. These experiences caused the highway engineer to direct the contractor to substitute the long steel trailer.

Facts sufficient to put a driver on notice of the condition of the road, the court said, are not to be confined to warning signs or written notices on such signs, but include as well all the easily visible physical indications upon or alongside the used part of the highway, including also those at the end, and even those shortly beyond the end of the usable part of the highway. Judgment for plaintiff was reversed for a new trial. (Graves v. Johnson, 176 So. 256.)

Liability for Harm Due to Material Falling on Highway

The Florida Supreme Court holds, Price v. Parks, 173 So. 903, that if harm is caused by the dangerous condition of a highway or public bridge held open for public travel, the right of action of the person harmed may be enforced against a contractor shown to have occasioned a dangerous condition of the highway or bridge by allowing materials from his vehicles to fall and negligently to accumulate on same, even though such contractor has assumed no duty to maintain or keep the highway or bridge in repair.

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

A radial well, believed to be the largest capacity ground-water collector ever built, has been installed at Canton, O. The well shaft is 12.5 ft. internal diameter and 147.5 ft. deep, made of sheet steel covered with reinforced concrete. From it thirty-six 8″ pipes of copper-bearing steel radiate horizontally, extending an average of 78 ft. (the longest 175 ft.), and containing 1½″ x ¼″ slots, the total slot area being 1,120 sq. ft. Each of the 36 pipes has a valve inside the well, operated from the surface. In pushing out these pipes, sand was washed in through the slots, an average of 3 cu. ft. per lineal foot of pipe, leaving a gravel filter around the pipes. Five deep-well vertical motor-driven pumps installed 75 ft. below the surface have a combined capacity of 11,600 gpm. Tests indicate the well would yield 20 mgd with a 15 ft. drawdown.[E6]

Winter precautions in Ottawa, Ont., include cork board insulation of roofs of settling basins. Two 51″ steel pipes across a concrete bridge are insulated with three 1″ layers of hair felt covered with heavy roofing felt. A new 48″ steel-cylinder concrete pipe crossing river on separate steel structures is insulated with two 1½″ layers of rock cork applied over expanded metal with joints staggered and over this a ½″ coating of weatherproof plastic asbestos cement; in a space between the pipe and the expanded metal a steam pipe is placed for heating when necessary.

Fire hydrants are tested for flow during cold weather, and if this shows an abnormal drop the mains in the vicinity are heated by electric thawing machine without waiting for complete stoppage. Ice forming on the inside of the pipe disrupts the lime coating there and it is redissolved; so during cold weather the lime dosage is reduced to prevent excess lime tastes. Hydrant laterals and fire services are insulated with hair felt and mineral wool covered with ready roofing and sealed with pitch; where possible, a service connection is tapped in a hydrant lateral to provide daily movement of water. All caps on hydrants are loosened a half-turn so they can be opened easily. Men are assigned districts, each to be responsible for all hydrants in his district and inspect them twice a week—daily in the business section; each man having 180 hydrants, or 90 in the business district. Large valves are steamed each night in extremely cold weather, and electric heaters placed in valve chambers on main feeders and where air valves are installed.

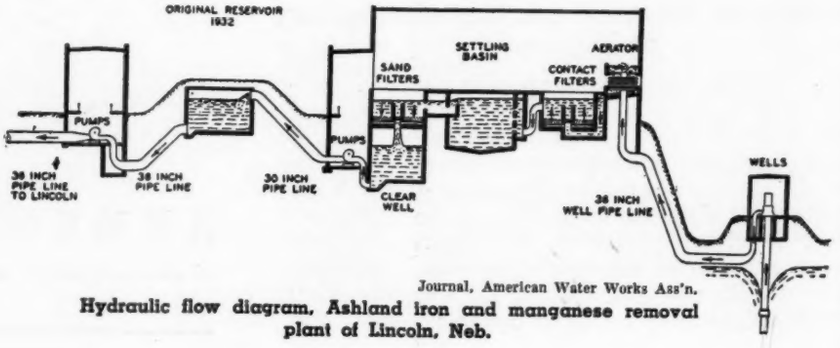
Five portable electric thawing machines are used, averaging in one winter 900 services, 30 mains, 2,000 hydrants and 100 valves; average time for thawing a domestic service ranges from 3 to 10 min., cost $1.78.[A17]

Iron and manganese removal in Lincoln, Neb., where water contains 0.25 ppm to 1.25 ppm of manganese and 0.3 to 0.6 ppm of iron, effected by: (1) Prechlorination at wells (keeps low service lines free from crenothrix). (2) Aeration; water drops through three tiers of 4 coke trays, 16″ apart vertically. (3) Chlorination of water leaving aerator about 1 ppm. (4) Contact filters, upward flow, 8 gpm per sq. ft.; filter medium, ¼″ uniform gravel. (5) Sedimentation, 2 hrs. detention. (6) Rapid filters, 4 gpm per sq. ft., 2 ft. of graded sand on 18″ of graded gravel. At present 35% of the raw water manganese is removed in the contact filters, 15% in the settling basin and 45% in final sand filters; iron is reduced to 0.02 ppm.[A18]

Anthrafilt, effective size 0.40-0.45 mm, uniformity coefficient 1.4, was placed 4″ deep on a 240 x 16 ft. sand filter of Eastman Kodak Co. (one of 16). Sand has effective size of 0.18 mm, uniformity 1.5. When washed with a Blaisdell washing machine, with teeth extending 12″ into the filter medium, there was considerable mixing of sand and coal. At first, washing at same intervals as sand filters gave an output 30% greater than sand filter; but after 5 months output was 2% less—probably because turbid matter penetrates below reach of teeth in the coarser material.[A19]

Color removal depends chiefly on production of a stable adsorptive floc which will settle rapidly, will not break up, will not redissolve nor pass the filters. With careful plant control such a floc can be secured. In a majority of soft colored waters it is necessary to correct the final reaction of the water to prevent corrosion in the distribution system. Both lime and soda ash can be employed. While it has been customary to leave the pH figure at 7.5-8, modern tendencies are to maintain the final figure at approximately 9.5. Standard practice is to secure a color of not greater than 20—15 is more desirable.[A20]

Color removal at Ottawa, Ont., the chief problem, is effected by coagulation, settling, rapid sand filtration, lime corrective treatment and sterilization. The raw water has a pH of 6.9 to 7.4; color 40 to 80; turbidity 7 to 100; alkalinity 15 to 38; total hardness 35 to 70. Coagulant used is alum, 2⅛ to 2¾ gpg; mixing time, average 80 min.; settling time, average 6 hr. 40 min. Average filter rate, 54 Imp. gal. per acre per day. Color reduced to 3. Filter effluent pH is 5.5 to 6.1, corrected by sufficient lime to convert all free CO_2 to calcium bicarbonate with a small excess, giving an effluent pH of 8.4 to 9.1.[A21]



Journal, American Water Works Ass'n.

Hydraulic flow diagram, Ashland iron and manganese removal plant of Lincoln, Neb.

91 helpful booklets and catalogs are described on pages 59-62. Look them over.

Bibliography of Recent Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

A *Journal, American Water Works Assn.*
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13. Charges for Fire Protection Service. By R. Nixon. Pp. 1837-1858.
14. Collecting Delinquent Accounts. By M. F. Hoffman. Pp. 1859-1867.
15. The Importance of Water Main Disinfection. By R. M. Harris. Pp. 1868-1875.
16. Problems in Control of Water-Borne Diseases. By F. W. Kittrell. Pp. 1876-1889.
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19. Use of Anthrafilt in a Slow Sand Filter. By A. C. Bailey. Pp. 1909-1915.
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23. Drought Conditions in Ontario. By A. E. Berry. Pp. 1938-1946.
24. The Quebec Streams Commission. By J. E. Gill. Pp. 1947-1954.
25. State Health Dept. Supervision of Watersheds of Streams. By H. P. Croft and D. M. Ditmars. Pp. 1955-1970.
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6. *p.* Subsidence of a Rockfill Dam. By R. G. Knight. P. 819.

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7. London's Water: Safeguards Against Pollution. Pp. 3-4.
8. *p.* Water Purification at Cork. By M. J. Riordan. P. 16.

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4. Pumps and Pipes Serve Three Objectives. (Golden Gate Exposition.) Pp. 1050-1052.

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5. Grouting Under an Earth Dam. Pp. 15-20.
6. Industry Taps an Underground Lake. By C. M. Maratta. Pp. 25-28.

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7. Winter and the Waterworks (at Eau Claire, Wis.). By W. W. De Berard. Pp. 103-105.

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6. Repair Shops at Lynn, Mass. By N. N. Wolpert. Pp. 1796-1799.
7. Delaware River Stream Pollution Control. Conference Report. Pp. 1800-1801.

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8. Water for Air Conditioning Demand Overestimated. By R. S. Thurston. Pp. 16-19.

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9. Playground for the Public (at St. Paul, Minn.). By L. N. Thompson. Pp. 78-81.
10. Zoning Regulations Held Not Applying to Water Tanks. By W. E. Thrasher. P. 87.

G *Water Works & Sewerage*
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4. *p.* Operation and Maintenance of Turbine Deep Well Pumping Units. By J. D. Campbell. Pp. 475-476.
5. *p.* Some Operating Kinks. By A. R. Todd. Pp. 477-479.

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6. Progress and Trends in Water Works During 1937. By L. R. Howson. Pp. 11-22.

J *American City*
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3. Heavy Chemical Treatment of Princeton, Ind., Water. Pp. 57-58.
4. The New Water Supply of Little Rock, Ark. Pp. 65-66.

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9. Studies of the Flow of Water in Bends. P. 39.
10. Additional Water for Air Conditioning in Chicago. P. 38.
11. *n.* Leakage Test of a 39-Inch Main. P. 45.
12. Broken Hydrants—a Drain on Taxpayers' Pockets. By H. Law. Pp. 51-52.
13. *p.* Cold Weather Precautions for Elevated Tanks. By F. O. Malloy. P. 52.
14. Remote Control for Small Pumping Stations. P. 53.

91 helpful booklets and catalogs are described on pages 59-62. Look them over.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

The Digestion Tank

Flat sewer gradients call for extra care in pipe laying and "the advantage of using spun concrete tubes in long lengths is very marked, their self-centering joints making a true bore and the pipes having a hard, smooth inside skin. . . . A sewer constructed with concrete tubes or with cast iron or steel in long lengths, with self-centering joints, can be laid with greater precision than stoneware pipes. The author feels justified in allowing flatter gradients with the former than with the latter, unless some patent joint is used."[D5]

Concrete segment sewers are being used in 22.5 miles of the London, England, sewerage for 4′ 6″ to 11′ 4″ sewers in tunnel. The segments are tongue and groove on both sides and ends, 4″ to 6″ thick, 12″ wide and about 3′ to 4′ long, so that five to nine segments and a key piece will complete the circle. The grooves are deeper than the tongues, and as soon as a ring has been set a steel reinforcing rod, bent to proper curvature and in two semi-circular sections is placed in the groove. After the next ring has been placed the joints are all pointed with cement and after this has set, grout is forced into the groove around the rods, and also into cavities between segments and ground. The segment sewer is generally lined with brick for resisting corrosion and erosion and adding strength to the sewer. These short segments make timbering unnecessary in most grounds and require less excavation than all-brick sewer and are much less expensive than cast iron or steel segments. The concrete is 1:2:4 cement-sand-gravel. Tests on 7′ 10″ sewer showed a strength under vertical load of 38.3 tons per running foot, which was 47% greater than a similar sewer before grouting. Lining with brick 4½″ to 9″ thick increased the strength two to four times.[G3]

Joint waste disposal at Cedar Rapids is unusual in several respects. Much of the sewage is industrial waste, largely packing plant. Construction and operation of the plant is financed by sewer rentals, of about 25% of water rates for domestic consumers and minor industries, but based on combined volume of sewage and BOD for the larger ones, except the packing house, which had a maximum waste of 3.4 mgd (maximum rate of other sewage was 10 mgd with 400 ppm of BOD). The industries had been ordered to treat their wastes, and studies indicated that cost of individual plants would be much greater, financing less favorable and proper operation less certain. The packing house made a separate agreement with city whereby it installed at its own cost grease removal and fine screen units (which yield a net profit), sewers to its various plant units, an automatic pumping station and pressure line to the city plant, a storage reservoir (to equalize flow), 2 clarifiers, flash mixer and flocculator and chemical equipment; also to pay parts of the cost of the general plant proportional to the estimated demands by packing house waste—12% of filters and final clarifiers, 21% of outside pipe lines, 7% of primary clarifiers, 53% of digestion tanks and of vacuum sludge filters and 8% of miscellaneous costs; the city to be paid in 20 annual installments with 4% interest. Also the company pays $4,000 a year toward plant operation costs and discharges condenser water into the sewers when requested (for sewage dilution or increasing its temperature). The final cost allocated to the company was $137,000 (reduced from actual cost 30% by PWA grant), while it had been estimated that an individual plant to produce similar results would have cost the company $309,000. The BOD of the packing house waste, about 3300, is reduced about 50% before discharge into the sewer. The general plant produces an effluent averaging 62 BOD, giving a demand of 3,751 lb. a day—about ¼ the minimum dissolved oxygen content of the river. The plan has worked admirably.[C5]

Sulfite waste liquor has the greatest pollution effect of any pulp or paper mill waste. It yields, by fermenting the sugars, bakers' yeast, alcohol (but this cannot compete commercially with that from molasses) and other products. Evaporation or precipitation to at least 50% solids gives a liquid fuel which furnishes heat for the evaporation; or lime precipitation produces a ligneous material that has been used in several ways.[C9]

Industrial wastes reaching sewers are divided by A. L. Fales into 12 general types. 1—Practically clean water (cooling or condensing) should not be discharged into sewers. 2—Hot liquids (above 140°) may injure sewers and promote septic action; should be cooled in heat exchangers, cooling ponds, etc. 3—Inflammable substances (gasoline) cause explosions in sewers, pumps, etc.; should be excluded from sewers. 4—Acid wastes disintegrate concrete, corrode pumps, interfere with biological processes. A pH of 4.0 is the minimum permitted in concrete sewers in Maryland. Only practicable remedy is exclusion. 5—Other harmful chemicals from beet sugar factories, copper working, etc. 6—Oil, grease and tar, from garages, oil refineries, packing houses, etc., should not be discharged into sewers, but removed by the industries responsible. 7—Appearance and odor-affecting—dye wastes, creamery, etc., giving putrefying odors. 8—Wastes high in suspended solids, increasing burden on plant, as paper mill "white water" spent hops, slaughter house solids, should not be admitted. 9—Solids of high specific gravity—sand, carbon, etc.—cause deposits in sewers and hard sludge in tanks; should be excluded from sewers, as by presedimentation. 10—Coarse suspended matters from wool and felt mills, block sewers, overload screens, form scum in tanks. 11—Wastes high in dissolved and colloidal organic matter—from distilleries, canneries, beer slop, etc. Pretreatment is generally necessary. 12—Wastes subject to precipitation of solids; may be of advantage in chemical precipitation, as acid-iron wastes, but more often precipitated matters clog filter, air diffuser plates, etc.[C7]

The trends in industrial waste treatment include (1) Use of biological processes for non-toxic wastes, and assistance of chemical and mechanical processes for both wastes and sewage; (2) use of these as recovery

processes to reduce cost; (3) recovery of expensive materials from wastes, and dialysis and electro-separation of recoverable colloidal and molecular material; (4) use of thermophilic processes to shorten time of digestion and decompose substances less readily attacked under mesophilic conditions (ex. wool fiber); (5) adsorption by chemical flocs or industrial or sanitary sludges of toxic components of wastes as a preliminary to biological treatment; (6) need of improved and more rapid methods of analyzing wastes.[C8]

Acid wastes in the Ohio river greatly reduce the bacterial pollution due to sewage. At Wheeling, W. Va., with a sewered population above of 2,186,500, the residual population equivalent in winter averages 569,-150 uncorrected for acid wastes, but is reduced to 155,-800 when corrected for the effect of these; and at low stages of the river in summer the population equivalent is 167,080, reduced to 1,465 by the effect of acid wastes. "The present benefit received from the presence of acid wastes in the upper river . . . is of such magnitude that the removal of these wastes, or their substantial reduction" (resulting from mine sealing and other corrective measures in progress) "doubtless will bring about a serious over-burdening of water purification plants both in this upper section and possibly at some points below Wheeling, unless provision is made for extensive treatment of sewage now discharged into the river. [K2]

The total acid pollution from all mines in the Ohio basin is estimated to be more than 15,000,000 lbs. per day, two-thirds of which is from abandoned mines and is being reduced very appreciably.[K5]

Digestion gas at Santa Clara, Calif., averaged 6.21% hydrogen sulfide (only 46.75% methane) which seriously corroded the boilers of the gas utilization plant and a scrubber is to be installed and it is believed that it may be commercially feasible to treat the scrubber solution and obtain a sulfur sludge of a rather high commercial value. . . . Because of its extreme fineness it is particularly effective in the prevention of green mold and control of the red spider. . . . It can also be used quite effectively if mixed with ordinary sulfur used in spraying.[C12]

Trickling filters when dosed at high daily rates serve primarily as flocculators, and the over-all efficiency of the plant is largely dependent on that of the final settling, the BOD of the effluent being due largely to finely suspended solids. The mediums for high-rate filters should be prefabricated material or rock not less than 1½ in. diameter. When such coarse rock is used for these filters they are free from ponding difficulties and Psychoda nuisance. Aerofilters have been used a year or less at Renville, Minn., River Falls, Wis., McCook, Ill., and Port St. Joe, Fla. At Renville a motorized disc distributor is used (probably not successful for beds over 20 ft. diameter). A Page distributor is used at River Falls and Clear Lake, Wis.,—a rotary distributor with centrifugal nozzles of ceramic material giving a rain-like spray over the entire surface all the time.[H7]

Vacuum filters of the multiple-compartment drum type, originally used for dewatering industrial sludge, now used for sewage sludge, were invented by George Moore in 1903. They were first used in regular service for sewage in 1925 (Oliver filters). Now three firms supply them—United Oliver Filters, Inc.; Filtration Equipment Corp.; Filtration Engineers, Inc. The filters are customarily built in drum diameters of 1, 2, 3,

4, 5, 6, 8, 10, 12, 14 and 18 ft. and drum lengths of 1 to 10 ft. The drum revolves at ⅛ to 1 rpm, depending on the character of the sludge. The performance is measured by the pounds of dry solids in the sludge cake produced per square foot of filter surface per hour, which varies from 2 to 8. The power required for operating the filter and its auxiliaries is about 0.06 to 0.1 hp. per square foot of filter. The drum is covered with a cloth (as the filter medium) which is usually woolen for acid sludge and cotton for alkaline; held on firmly by spirally wound wire in the Oliver. In the Conkey (Filtration Equipment Corp.) and Oliver, the sludge cake is loosened from the cloth, when or just after it reaches the horizontal diameter on the descending side, by blowing air through the cloth, which also cleans the pores of the cloth. In the FE (Filtration Engineers) string discharge, strings spaced ½" apart surround the ascending, top and top half of the descending sides of the drum, leaving the drum tangentially at about the horizontal diameter, then passing around a small roller and returning to the drum; which strings in leaving the drum pull the cake from the cloth. S. I. Zack (Filtration Equipment Corp.) says: "As open a filtering medium as possible should be used. In filtering nonrigid solids, pressure does not necessarily make a dry cake. A thin cake offers lower resistance than a heavier one and consequently is easier to dry. The filter cake must be uniform in porosity and in thickness for good drying. Proper sludge conditioning—involving considerations of coagulating time, quantity of chemicals and character of mixing—is essential to successful and economical sewage sludge filtration." Of the 129 Oliver filters furnished to 50 plants, 41 have been for activated sludge, 31 for digested primary, 28 for raw and activated mixed, 16 for raw, 9 for chemically precipitated and 4 for raw and activated digested.[G7, 8 & 9]

Flocculating tanks in the Minneapolis-St. Paul treatment plant are designed to be used as settling tanks for 90% of the time, when chemical treatment will not be employed; or they may be used as post-chlorination contact tanks or as grease-separating tanks, or as a bypass channel, or (since aeration is used for flocculation) for "freshening" the sewage with air. The tanks are 290 ft. long, average water depth 15 ft. 6 in., maximum width 17 ft. 9 in., designed for spinal flow produced by porous diffuser tubes, rated permeability 50 in the first eighth of the tank and 30 in the last seven eighths. Detention period, 24.5 min. Conveyor-type sludge removal mechanism with flights 14 ft. wide.[C2]

Effluent filters of the downward-flow magnetic sand type are provided in the Minneapolis-St. Paul treatment plant, 8 in number in 2 batteries. Total filter area, 31,200 sq. ft., giving filter rate of 3 gal. per sq. ft. per min. Will be cleaned by a solenoid which passes over the bed at 4 to 8 ft. per min., automatically started by differential head on filter.[C2]

Stream flow regulation, by preventing low flow, decreases the amount of sewage treatment necessary by cities along the stream. The Pennsylvania Dept. of Health had required communities on the Beaver and Shenango rivers to install treatment plants providing for oxidation and chemical disinfection as well as removal of settleable solids. Flow regulation has been obtained by construction of the Pymatuning reservoir, by which an average flow was maintained at Sharon of 175 cfs (minimum 100 cfs) during conditions which would otherwise have reduced the flow 30 or 40 cfs average and less for short periods. Because of this, the Department believed that sewage plant effluent could safely be assimilated with a lesser degree of treatment and permitted the omission of oxidation in treatment plants.[K3]

Fertilizing value of sewage sludges depends on availability of nitrogen in them as well as percentages of nitrogen, phosphoric acid and water-soluble potash. Digested sludge is somewhat comparable to farm manure but contains less easily decomposable nitrogen and potash, the former having been digested out and the latter washed out. But activated sludge retains most of its organic solids, is fairly low in ash, and its 5 or 6% of nitrogen is about half as readily available to growing crops as that in nitrate of soda. Both digestion and the activated process reduce the ether-soluble content so as to be unobjectionable for fertilizer, although mineral oils or greases may prove troublesome. Somewhat less than 50,000 tons of dry solids, containing about 3,100 tons of nitrogen, are recovered as activated sludge annually in the U. S. If all the sludge from all the sewage plants in the country, serving 37,000,000 people, were digested the sludge would contain about 11,420 tons of nitrogen, or less than 5% of that sold in commercial fertilizers, and no glut in the market would occur. Well digested sludge contains no germinatable seeds except perhaps some tomato.

Wet digested sludge is applied directly to the soil only (it is believed) in Canton, O. and Plainfield, N. J. Air-dried digested sludge is used for fruit trees, shade trees, shrubs, vegetables, flowers, lawns. When exposed on the surface, as on lawns, odors are likely to occur for a considerable time. Grinding may prevent odors and destroy seeds and makes it easier to handle. Digested sludge is sold at 25 cts. to $12 a ton, or $15 when specially processed.

Heat-dried activated sludge, more generally used as fertilizer because of its greater nitrogen content, is produced by Chicago, Houston, Milwaukee and Pasadena. The three latter (Chicago's plant had not yet started) in 1936 sold 51,951 tons. Air-dried digested activated sludge is used by a few cities in Southern California, Arizona and Texas, largely for citrus orchards. Altogether probably 450,000 tons of sludge are used as fertilizer annually in the U. S.[C1]

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c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

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8. *p.* Refuse Disposal Practice in Sheffield. By R. A. Richmond. Pp. 767-768.

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17. Some Successful Methods of Clearing Obstructed Sewers. By J. S. Wiley. P. 51.
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Sanitation Beyond the Sewer Lines—the Engineer's Problem

FROM 20% to 30% of the homes in the average city of the United States are not served by sanitary sewers; in the built-up areas outside of the city limits the percentage is, as a rule, much higher; and still farther out are other homes, gasoline stations, restaurants, road houses and camps, many of which are served by running water, either from city mains or from private supplies, but few by sewers.

Health protection and nuisance are involved very deeply in this matter, and since neither odors nor pathogenic bacteria recognize city limits or man-made boundary lines, the residents of the neighboring areas are interested also. These subjects are both worthy of thorough discussion, but this article will be restricted solely to the designing and installation of individual sewage treatment plants for homes, stations, camps and other similar places, which is a problem for engineers.

Field for the Engineer. The need for individual sewage treatment plants affords a field of work for the engineer; he is particularly fitted to do such work and will find it often a source of added income. In the past, a great many of these installations have been made by plumbers, concrete workers, and others, in which cases the results have not always been satisfactory. It is a tribute to the ability of the small septic tank to work and give satisfaction under adverse conditions that such a high percentage of them have given satisfactory service.

Method of Treatment. The small septic tank, with secondary treatment of the effluent in accordance with local conditions, is the most satisfactory and economical method of handling the problem. In a few areas of very favorable soil conditions, cesspools of the various types may also perform satisfactorily. Secondary disposal may be accomplished by subsurface tile lines, sand filters, seepage pits or, in the case of larger installations, trickling filters.

Size of Tank. There are many varieties of regulations extant governing the size of septic tanks. Most of them originate with the state health departments; in some cases cities have regulations also. Of course, these regulations must be followed; and in most cases they are based on sound experience in installation and subsequent service, so that compliance with them is a safeguard rather than a handicap. The first step, therefore, should always be to study state or city regulations carefully.

When these regulations permit, as they usually do, the minimum capacity should be 300 gallons for a single family of not more than 7. In a few places larger tanks are required; some permit 200-gallon units. The cost of the larger tank is not much greater, and where required it of course should be used. Its use affords some reserve for increasing size of families, for week-end or holiday overloads, and for other more or less unexpected events.

Design of Tank. Complicated design should be avoided. A simple cylindrical or rectangular tank is best for small installations; even baffles are not needed if the inlet and outlet have down-turning tees or elbows of the proper length. A depth of at least 30 inches should be provided. Excessive capacity, above 50 or 60 gallons per person, is wasteful and of no value.

The tendency is great to produce a complicated and costly tank. At one time the writer had a collection of such designs. Believe it or not, one of these had a roughened belt of concrete which was designed to "provide a resting place for bacteria when not engaged in destroying the organic matter." Others had tortuous passages to separate the various kinds of bacteria, steps to facilitate their passage from one chamber to the next, and ingenious devices of one kind or another that added to the cost and, if they did not actually interfere with the proper functioning of the tank, at least did not help it perform better.

Material of Construction. Most septic tanks of the sizes discussed in this article are made of metal or of concrete; a few are of tile or wood. Wood has not been widely accepted, and the contraptions of this sort placed in so many CCC camps were practically a total loss. Tile is not ordinarily made in sizes large enough to provide necessary cross-sectional area and depth; one or the other can be obtained, but not both.

The manufactured metal tank is probably the most economical and satisfactory. It is generally well-designed; light and easy to handle; can be purchased from most plumbing supply houses; and installation is quick and practically fool-proof. Perhaps its principal advantage from the viewpoint of the engineer is that its use greatly reduces the amount of personal supervision necessary for securing a good job, and shortens the time of doing the work.

The concrete tank built in place also gives excellent service. It requires close supervision to see that all details are properly built, that swelling forms do not crack the tank corners, etc. If properly designed, the floor and walls can be poured in one operation, grooves being left for inserting baffles, if these are to be used.

Either, when properly installed, will give good service for many years. Metal tanks have been in use now for 20 years, and concrete tanks for a longer period. Under any usual conditions, the life of either type of tank is beyond the design-life of the installation.

Location of Tank. In most cases the tank may be installed close to the home or building it serves—10 to 25 feet is good practice. It should be away from the drip of eaves, and protected from surface water flows. It is best to avoid low areas, locating the tank on ground as high as possible consistent with proper grade for the sewer from the house.

Depth of Tank. Many homes have fixtures in the basement and on sidehill locations the tank may be set downhill far enough so that it can serve basement fixtures. But except in the most favorable, porous soils, it is better to keep the tank near the ground surface; a cover of 12 to 18 inches is best. If basement fixtures must be provided for, it is far better to install a small sump and automatic pump or ejector than to place the tank several feet underground.

Details of Installation. The tank itself should be water-tight, in order not to permit the liquid portion of the waste to leak out, leaving insufficient moisture for the proper digestion of the solids; also because it is undesirable to permit contamination of the soil with raw sewage. Ventilation of the tank is unimportant; tanks appear to work equally well whether they are vented or not. When inlets and outlets have down-turning bends, these should be T's rather than L's; a T does not appear to clog as readily as an L, and in case of clogging, they can be cleared more easily. Manholes or other means of access should be provided for reaching inlets and outlets. Metal tanks have removable covers, fastened by bolting; small concrete tanks may also have removable slab covers in one or more pieces. Manholes should be provided in larger tanks.

When the slope of the house sewer is flat, the grade should be increased for the 6 feet just before entering the tank. This reduces stranding of solids with small flows and also tends to prevent wadding of paper and solids in the inlet pipe or bend, since the increased velocity of flow carries such particles through into the tank.

When using metal tanks, care should be taken to set them level, and to have the inlet and outlet sides in proper place. A tank tipped toward the inlet side tends to clog because the outlet is then higher than the inlet and sewage backs up in the house sewer. With concrete tanks, the inlet should be one or two inches higher than the outlet for the same reason.

Properly planned and carefully built, an installation such as described will serve indefinitey. Under the direction of an engineer, some four thousand tanks were installed in a southern city in the years 1922 to 1926: and except where replaced by sewer lines, practically all of these are still giving satisfactory service; complaints regarding them have amounted to less than 1% of the installations per year, and in most of these cases the difficulties were minor ones.

Secondary Treatment. Methods of secondary treatment will be discussed in a later article. Readers desiring information regarding methods mentioned above can obtain it by writing to the editor of PUBLIC WORKS.

Water Department in Charge of Sewage Treatment

Several cities in a number of States are providing funds for operating their sewage treatment plants (and sewerage systems also in many of them) by means of sewer rental charges based on the amount of water consumed. The expenditure of such funds, however, is generally in the control of the sewer department. Yakima, Wash., has gone a step further. It has just placed in operation a treatment plant under the jurisdiction of the Water Department, the cost to be paid from the funds of that department. It is thought possible, we believe, that the present water rates will suffice for this additional service; whether or not they have to be increased, the sewage treatment is paid for directly by the water consumers on the basis of the amount of water used.

This plant consists of grit channels (emptied through bottom openings into a small car); two 25″ comminutors; four Dorr Clarifiers 90 ft. diameter by 8 ft. side water depth, one of which can be used as a chlorinating basin, receiving the effluent from the other three; three sludge tanks, one for storage and two for digestion with Dorr equipment; six 50 x 100 ft. sludge drying beds; and a building containing sludge pumps, heating plant, chlorinating and controlling equipment, recording devices and laboratory. The cost was a little over $160,000, part contributed by W P A.

MC Asphalts in Road Construction

J. W. POWERS
Engineer of Materials, Arizona State Highway Department

MEDIUM curing asphalt cutbacks have the following advantages for plant and road-mix work: 1. They develop a stronger binder than the SC materials; 2. There is no appreciable loss of workability under favorable conditions during the mixing period; 3. Sufficient binding strength is developed to lay successfully low filler content aggregates; 4. The residual product is of rather soft consistency which should contribute to long life; and, 5. MC products are less susceptible to displacement by water than SC products.

There is one possible discordant note—that after it has been down for an appreciable time, reworking of the heavier grades may not be as easy. If there is adequate provision for a stable base, this need not be a consideration.

Nearly all specifications covering the grading of aggregates for cutback mixes specify a maximum size of 1-inch or ¾-inch square. The grading adopted by the A.A.S.H.O. Committee on Materials is as follows:

Passing 1-inch sieve	100%
Passing ¾-inch sieve	85% to 100%
Passing No. 4 sieve	45% to 65%
Passing No. 10 sieve	30% to 50%
Passing No. 200 sieve	5% to 10%

In addition to this, a uniformity clause requires that the material passing Nos. 4 and 10 sieves shall not vary more than 5% in any run, and that the material passing the 200-mesh sieve shall not vary more than 2% under the same conditions. The percentage of cutback asphalt necessary for this grading will be between 3.5% and 4.5%. In using MC material with different gradings of aggregates, the workability of the mix—or, in other words, the practical side of laying a smooth road—is a function of both the percentage of diluent and the minus 200 material. High concentrations of minus 200-sieve material are hard to mix and difficult to expel the diluent from. Therefore in selecting the grade of MC to be used, the basis must be past experience. However, under normal working conditions, which may be limited in some states to a few months each year, the following is a rough guide for selection. It is based on the percentage of material passing the 200-mesh sieve.

% Passing 200-mesh	For Road-Mix Use	For Plant-Mix Use
Below 8%	MC-4	MC-5
8% to 15%	MC-3	MC-4*

Note: *MC-4 for blade lay; use MC-5 if machine laid.

In any case, the selection should use the least diluent possible, as this gives the highest percentage of residual binder and is less likely to permit surface irregularities due to lubrication from the retained diluent.

The MC-1 and MC-2 grades serve very well as materials for prime coats or asphaltic surface treatments. In either case, the selection will depend upon the materials to be treated. The more dense the grading, the lighter should be the product for good penetration.

For protection of the underlying mix and to provide fully non-skid surfaces, seal coats are needed. Cutback products are admirably suited for this purpose. Usual methods involve a direct application of the cutback and subsequent covering with screenings, or pre-coating the

screenings and applying without a tack coat, depending upon the tackiness of the newly-built pavement and the coated screenings to provide adequate bond.

For the first method, the usual application will vary from 0.15 to 0.30 gal. per sq. yd., with screenings applied at the rate of 1 pound for each 0.01 gal. of cutback applied. Grading of such screenings have varied widely; present specifications of the A.A.S.H.O. are:

Passing ½-inch sieve	100% by weight
Passing ⅜-inch sieve	90% to 100% by weight
Passing No. 10 sieve	0% to 5% by weight
Passing No. 200 sieve	0% to 2% by weight

Where this method of seal coating is used, the lowest practicable diluent content cutback should be applied in order to develop a good grip on the screenings.

When a pre-coated graded aggregate is used, 3% to 5% of cutback asphalt is used, and 25 to 35 pounds per sq. yd. of the coated material is applied, and rolled into the pavement. Grading should be approximately as follows:

Passing ⅜-inch sieve	100%
Retained on No. 3 sieve	Not more than 15%
Passing No. 10 sieve	25% to 45%
Passing No. 40 sieve	7½% to 17½%
Cutback asphalt	3% to 5%

The type of cutback used can be the same as that in the mix.

Other applications of cutback have been in the field of maintenance. MC-2 is an excellent material for producing stock-piled patching material, and experience in my state shows that it can be piled for a year or more and be as workable as when originally produced. When freshly mixed, the material does not adhere well, but after a short curing period it loses its oiliness and becomes tacky. For shorter use periods, MC-5 seems more advisable.

The Arizona Highway Department uses the following grading for this type of material:

Passing ½-inch sieve	100%
Passing ⅜-inch sieve	85% to 100%
Passing No. 3 sieve	70% to 80%
Passing No. 10 sieve	65% to 75%
Passing No. 200 sieve	7½% to 12½%
Cutback Asphalt	4% to 6%

In selecting aggregates for stock-piled mix, it is not advisable to use absorbent aggregates, as they absorb the kerosene and tend to leave a crackerjack-like material not suited for the purpose intended.

We have also used cutback mixes for surfacing laminated bridges, using the following grading:

Passing 1-inch sieve	100%
Passing No. 3 sieve	45% to 60%
Passing No. 10 sieve	Not less than 30%
Passing No. 200 sieve	Not more than 5%

This material is an abstract of a paper presented by Mr. Powers at the meeting of the Asphalt Institute, Memphis, Tenn., in December, 1937.

Curves on Highways Are Not Defects

Under the Kansas statute the state is not an insurer of travelers on its highways; nor is it required or expected to have perfect highways. Acting through the State Highway Commission its purpose is to improve highways. Curves in a highway do not make it defective, and where a highway with its curves is constructed in accord with standard improved methods, and appropriate signs have been placed in proper position, the commission is not liable to a motorist who strikes an upright white cement post set to mark a curve and culvert. (Parsons v. State Highway Commission, Kansas Supreme Court, 72 P. [2d.] 75.)

91 helpful booklets and catalogs are described on pages 59-62. Look them over.

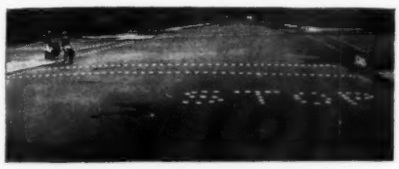
Keeping Up With New Equipment

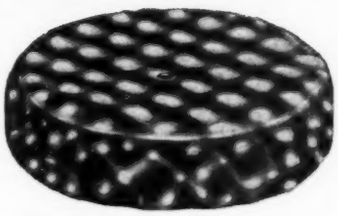
Moonbeam "Can-Lid" Road Marker

A new reflecting traffic marker has been placed on the market by Highway Steel Products Company and is sold under the trade-name "Moonbeam" Road Marker.

This product is in the shape of a can lid and is made of stainless steel provided with indentures to reflect light rays in every direction.

These markers are designed to be installed in the pavement at the time the road is constructed and no special equipment is necessary because they become firmly anchored in the concrete or asphalt by the rough edges of the marker.

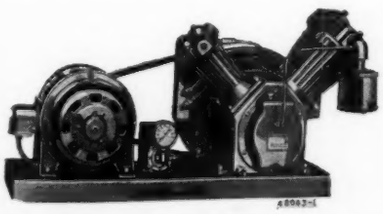




The "Moonbeam" reflector and above, a night view showing visibility

It is claimed that Moonbeam Road Markers will reflect lights much more efficiently because of the indentures in the stainless steel and that highway traffic will keep the surface of the marker highly polished at all times. The manufacturers of stainless steel assert that salt, calcium chloride and other chemicals used in ordinary highway work will have no effect on its brilliance.

Further particulars on this product may be obtained by writing Highway Steel Products Company, Chicago Heights, Illinois.

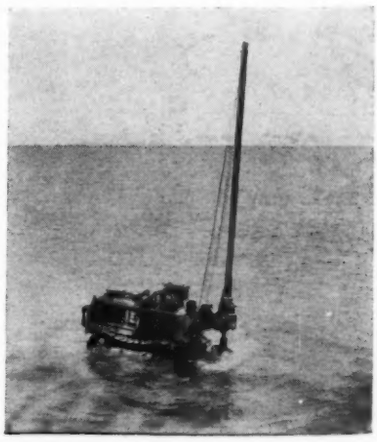


Ingersoll-Rand Type 30 Industrial Compressor is made in sizes from ¼ to 15 h.p. Ask for bulletin 2118, Ingersoll-Rand, 11 Broadway, N. Y.

The Etnyre "Streamliner" street flusher designed for the New York World's Fair. Painted in red and black.

A New Koehring 1½-Yard Shovel

If the new 603 Koehring is half as nifty as the bulletin describing it, purchasers will have a mighty fine shovel. As for the machine itself, it has enclosed gears, anti-friction bearings, selective swing speeds and shock absorber. The catalog, in addition to a really good description of the new shovel, is excellently illustrated in several colors. Sent on request to E. J. Goes, Koehring Co., Milwaukee, Wisc.



Building a sea-wall near North Beach, Md. Caterpillar tractor and highway earth boring machine boring 16" holes 9" deep.

Illuminating Airport Runway Edges

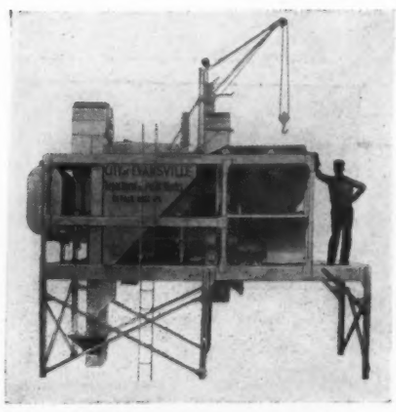
By mounting small reflectors contained in metal housings along the edges of airport runways, a satisfactory but inexpensive illumination of the edges is obtained. There is no maintenance cost; the landing lights of the airplanes are sufficient to furnish the beams for reflection back to the pilot. The reflecting lenses are small, but amply brilliant. Further information from Dickson Highway Safety Marker, Orlando, Fla.

Dayton-Dowd CCC Pumps

Not for CCC camps, but close coupled centrifugals. Contains 12 pages of capacities, sizes, etc., of the pumps and 4 pages of excellent enginering information, including "How to figure a pumping problem," friction head losses, pumping cost computations, etc. C. N. Adams, Dayton-Dowd Co., Quincy, Ill. Ask for Bulletin 805.

Asphalt Patch Plants

Even the best of pavements need patching from time to time and pre-mixed material has been found most adaptable for such work. Hetherington & Berner have brought out an asphalt patch plant which is said to produce small quantities efficiently and economically. The processing of materials is identical with that employed in large plants. Material to meet any standard hot-mix specification can be manufactured in it. The capacity is 3 to 5 tons per hour; it is furnished in both portable and stationary types. Portable units have rubber-tired wheels and conform to highway and street regulations; a short-turning radius is provided. For information, write Hetherington & Berner, Inc., Indianapolis, Ind.

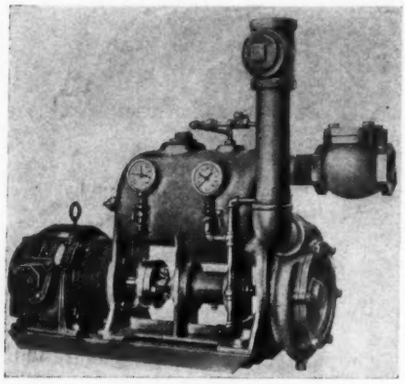


New H. & B. Patch Plant

KEEPING UP WITH NEW EQUIPMENT

A New Self Priming Pump

The Hazleton-Auto-Pump combines in a compact unit, a pump and a priming tank, adaptable to full automatic control. Its outstanding feature is, that only part of the air handled during the priming period, passes through the pump. The greater part is expelled from the priming tank directly into the discharge line. The priming tank retains sufficient water to prime a short suction line. Repeated starts are necessary to prime long lines, the number of starts depending on the length of the line and the suction lift. A very high vacuum can be obtained.



Hazleton-Auto Pump

Once primed, the pump will hold its prime for days, because it is under pressure when standing idle, and air cannot leak into the casing through the stuffing box. The priming cycle can be controlled manually or automatically.

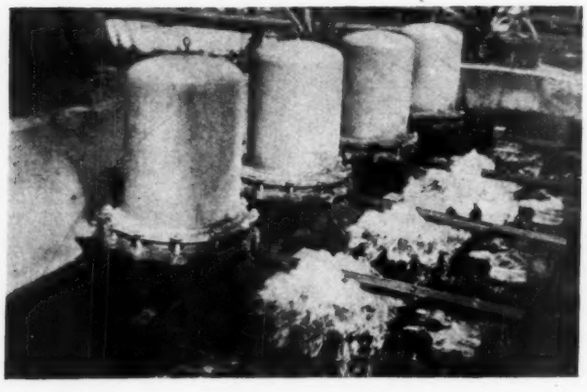
Auto-pumps are available in six sizes ranging from 1 to 15 h.p., 1800 and 3600 r.p.m.

For full particulars write to Barrett, Haentjens & Co., Hazleton, Pa.

United States Pumps in the Dominican Republic

The export trade of this country is a subject of more or less worry in Congress, but not in the office of the Rife Hydraulic Mfg. Co., which is selling rams for export in increasing numbers. The illustration shows a battery of four No. 80 Rife Rams in operation in the Dominican Republic, using 13 feet fall and lifting water 100 feet high, delivering 100 gallons a minute or 144,000 gallons a day. Two additional units of the same size have since been added.

Battery of Rife hydraulic rams



Electric Concrete Vibrator

Syntron Co., Homer City, Pa. have announced a new electric motor-driven, internal type of concrete vibrator to vibrate concrete. The equipment consists of three pieces — an electric drive motor mounted on two small wheels—a variable length of flexible shafting and the vibrating tool, which is immersed in the concrete. The motor operates on both 110-220 volts, single phase, A.C. and has a built-in gear box that increases the driving speed to 7200 RPM. Complete detailed catalog information is available from the manufacturer upon request.

Electric Concrete Vibrator

New Features on Kinney Distributors

The Kinney Mfg. Co., Boston, Mass., exhibited a most modernly designed bituminous distributor at the Road Show. Among the features of interest are the use of an alloy steel tank of high-strength steel, thus reducing deadweight; the use of the Ford V-8, 60 hp. engine for the oil pump, thus giving surplus of power for handling sticky or viscous, quick-breaking emulsions; and Westinghouse air controls on the distributing valves.

These controls can be located both in the cab and on the rear platform, so that one-man operation of the distributor is possible. Turning one air-cock closes circulation and starts spraying; turning it back stops application.

Bulletin A 1938 describes Kinney Distributors. It will be sent on request to the above company.

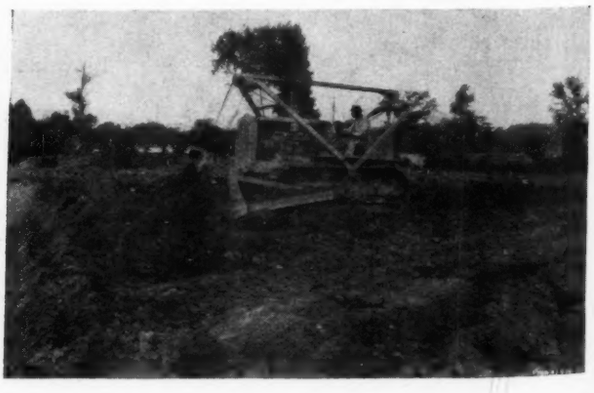
Gifford-Harding Co., Dedham, Mass., electric pipe thawer is especially designed for thawing services. Handy to carry, quick and effective; operates on 110-volts. Booklet on request.

The Etnyre "Blacktopper"

E. D. Etnyre & Co., Oregon, Ill., have introduced a new distributor, called the "Blacktopper." This features one-man operation through air controls in the cab, and many other improvements. Exact application between the ranges of 0.10 to 3.00 gallons per square yard is claimed, without dripping or leaking.

This company has also announced a new tank car heater and booster that uses no water or steam, but gives fast heat. The new distributor is described on Catalog 508, and the heater and booster in a folder. Either or both will be sent on request.

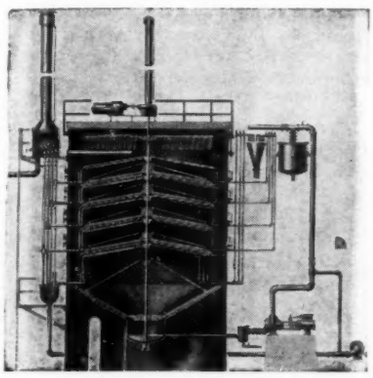
Caterpillar diesel R D 6 and LeTourneau bulldozer building dam on Warrior River near Tuscaloosa, Ala.



A Multi-Tray Clarifier

The Seip multi-tray clarifier is designed and built on the principle of upward sludge filtration by means of periphery intake channel of very large size. The clarifier consists of one, two or as many as seven (depending on the size of the tank and the capacity required) round, inverted trays, supported by brackets attached to inner side of tank shell.

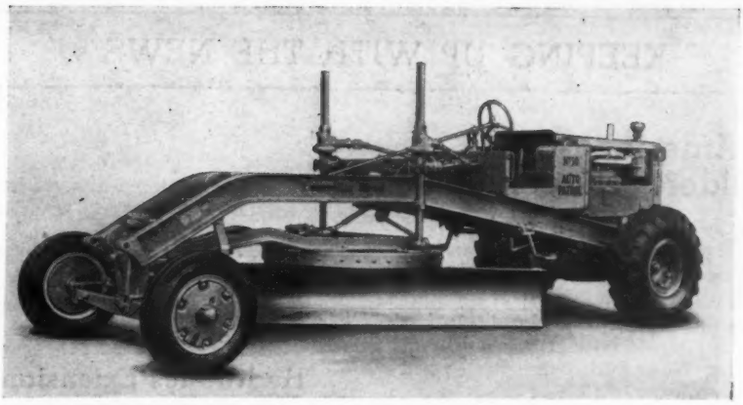
The space within each tray forms a settling chamber and these solids collect on the top of each tray. Immediately above each tray there is a set of movable scrapers to carry away the surplus sludge. These scrapers are operated from a central shaft, the speed of which can be changed to suit specific gravity of sludge encountered and the depth of sludge desired.



Seip tray clarifier.

The Graver Tank & Mfg. Co., Inc., with plants at East Chicago, Ind., and Catasauqua, Pa., are marketing this clarifier. Descriptive material on request.

Jahn utility trailer for 5- to 15-ton loads conforms to all state regulations regarding overall widths, lengths and wheel designs.



The new Caterpillar No. 10 (also made in diesel) uses single low pressure tires. Large area of ground contact gives high traction.

The Straightflo—a New Type of Centrifugal

Morris Machine Works, Baldwinsville, N. Y., have issued a bulletin (No. 167) on their "straightflo" centrifugal, which is a marked departure from usual centrifugals. The specially formed casing and screw type propeller, it is said, give high efficiencies when direct driven by standard high-speed motor on both clear water and sewage. Furnished in 10-inch to 24-inch sizes, 1500 gpm and up.

Koehring Concrete Mixers

This is an announcement, really, of a new catalog describing the Koehring Dandie Mixers, 7S, 10S and 14S. Has lots of good data, including approximate working capacities of these sizes, with volumes of materials; complete dimensions; specimen setups, etc. You'll like the color arrangement of this catalog; something new and unusual. Ask E. J. Goes for the Dandie Mixer catalog. Address him care of Koehring Co., Milwaukee, Wisc.

Middlesborough Flood Protection

The U. S. Government has appropriated $536,000 to match $60,000 by the city of Middlesborough, Ky., for constructing a channel to divert flood waters around the city. Work will begin early in 1938. Edw. L. Johnson is city clerk.

55 Miles of Fence for Water District

The Metropolitan Water District of Southern California has purchased from the Anchor Post Fence Co., Baltimore, Md., 55 miles of chain link fence, 6 feet high. The contract amounts to $180,000. The fence will be used around reservoirs and on both sides of the open sections of the Colorado River aqueduct.

Gardner-Denver, Quincy, Ill., close coupled centrifugal. Capacities up to 250 gpm and heads up to 250 ft.; speeds 1750 and 3460 rpm. Ask for Bulletin A-201.

Catalogs and Booklets

Rotary Displacements Meters lists meters, gives general operating principles and shows proof curves. Ask for 40-B-12, Roots - Connersville Blower Corp., Connersville, Ind.

Crushing and Screening Plants, Austin-Western Road Machinery Co., Aurora, Ill., 8 pp., describes the new No. 70 and No. 80 portable crushing and screening plants. Another 12 pp. booklet describes the No. 100 plant.

Calcium Chloride Data

Better Concrete Curing, an 8-page bulletin by Calcium Chloride Assn., Detroit, Mich., gives valuable information on how to get better concrete. Specifications sent on request.

Ice Control, Calcium Chloride Assn. Bulletin 36, contains a lot of specific information on how to have safe highways and streets under almost any weather conditions. 8 pp. Sent on request.

4-yd. medium duty truck owned by city of Columbus, O. Autocar chassis; Gar Wood body with extension sideboard; double acting tailgate; 9.75x20 tires. A type of unit of all-around usefulness in municipal work.

KEEPING UP WITH THE NEWS

American Road Builders' Association

Murray D. Van Wagoner, Michigan State Highway Commissioner, Lansing, is the new president of the American Road Builders' Association. He succeeds Colonel Willard T. Chevalier, vice-president of the McGraw-Hill Publishing Company, New York, who was elected to the presidency in 1935.

Other officers include Paul B. Reinhold, secretary-treasurer of Reinhold & Co., Pittsburgh, Pa., vice-president, northeastern district; E. D. Kenna, director of the Mississippi State Highway Department, Jackson, vice-president, southern district; Lion Gardiner, vice-president of the Jaeger Machine Co., Columbus, O., vice-president, central district; Stanley Abel, supervisor of the fourth district, Kern County, Taft, Cal., vice-president, western district, and James H. MacDonald, New Haven, Conn., treasurer.

A.R.B.A. directors for the next two years will be A. W. Brandt, commissioner of highways, Department of Public works, Albany, N. Y.; Carl W. Brown, chief engineer, Missouri State Highway Department, Jefferson City; Frederick Hoitt, secretary, New England Road Builders' Association, Boston, Mass.; C. J. Sherlock, first assistant engineer, Alabama Department of Highways, Montgomery; Charles M. Upham, engineer-director of the A.R.B.A., Washington, D. C.; Charles D. Vail, state highway engineer, Denver, Colo., and H. C. Whitehurst, director of highways, Washington, D. C.

William P. McDonald, Flushing, N. Y., and William R. Smith, Meriden, Conn., were elected president and vice-president, respectively, of the Highway Contractors' Division of the association.

New York State Sewage Works Association

The tenth annual meeting of the New York State Sewage Works Association was held in New York City January 20-22, 1938, with headquarters at the Hotel McAlpin. The attendance totaled 320, including 85 outside New York State from fourteen association affiliates of the federation.

C. George Anderson (Rockville Center), Henry Ryon (Albany) and William E. Stanley (Ithaca) were elected to the Executive Committee for a period of three years, and F. Arthur Cary (Fairport) was elected to fill the unexpired term of Harry Eustance who resigned. Fred J. Biele (Huntington) was elected president and Newell L. Nussbaumer (Buffalo) vice president. A. S. Bedell, State Department of Health, Albany, N. Y., was reappointed secretary-treasurer, and J. C. Brigham (Albany) was appointed assistant treasurer.

The program was arranged so that the members of the Sewage Works Association were able to attend also sessions of the Sanitary Engineering Division of the A.S.C.E. And in like manner the members of the A.S.C.E. attended the technical sessions of the N.Y.S.S.W.A. on Friday and the joint inspection trip on Saturday.

Hydraulics Extension Instruction

The Extension Division of the University of Wisconsin, at Madison, announces that its elementary course in hydraulics—the basis of designs for the distribution of water, collection of sewage, and transportation of oils — has been fully revised. The subject is taught by the department of civil and structural engineering by the correspondence-study method.

This course teaches the fundamental theory of hydraulics, including the flow of fluids in pipes and open channels; the various devices used to measure flowing fluids; and the pressure of fluids in submerged surfaces. Included in it is a practical application of the viscosity of fluids.

Courses like this, in the technical field, are offered by the University of Wisconsin as a convenient and practical means of working for professional fitness, without interrupting employment.

Howard S. Reed has been appointed State Highway Engineer of Arizona, succeeding the late T. S. O'Connell.

Don MacCrea, M. Z. Bair and K. W. Lefever have announced their association as individuals for consulting engineering. They will handle waterworks and water purification, sewers and sewage treatment, and roads and pavements. Offices will be in the Gazette Building, Little Rock.

Brooks Equipment & Mfg. Co., Davenport Road, Knoxville, Tenn., has been formed by the consolidation of the Day Pulverizer Co. and the Brooks-Payne-Osborne Equipment Co. Wallace Brooks is president.

Mall Tool Co., Chicago, Ill., has purchased the Wappatt Inc. Division of Simonds Saw & Steel Co. The Wappatt line, consisting of portable saws, grinders and drills, will be manufactured by Mall hereafter.

H. A. Hoffer, formerly eastern sales manager of U. S. Pipe & Foundry Co., Burlington, N. J., has been appointed assistant general sales manager; H. L. Nelson succeeds Mr. Hoffer as eastern sales manager; S. E. Linderman succeeds Mr. Nelson as Pittsburgh sales agent; and J. B. McFarland, formerly of the Chicago sales office, has been appointed publicity representative at Burlington, succeeding Ralph Shaw who resigned to enter business for himself.

INDEX TO ADVERTISEMENTS

Readers' Service Department

CONTINUED FROM PAGE 60

These booklets are FREE to readers of PUBLIC WORKS.

Air for Agitation

382. Roots-Connersville positive displacement blowers for moving air under moderate pressure or vacuum in volumes up to 700 cu. ft. per minute are described in Bulletin 21-B 17 recently issued by the Roots-Connersville Blower Corp., Connersville, Indiana. Blowers for larger volumes and higher pressures are covered under other bulletins which are available.

Cast Iron Sewers

384. Cast Iron Pipe for Sewers. For wet grounds, under highways and railways and other severe duty. Details and specifications. U. S. Pipe & Foundry Co., Burlington, N. J.

385. For use in wet ground to prevent infiltration, for crossing under railways and heavy duty highways, and for all other sewer construction where replacement, repairs or reconstruction would be costly, cast iron pipe is most economical. For details, specifications, etc., write Thomas F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Couplings for Pipe

386. This sixteen-page booklet is a reprint of a magazine article by a consulting engineer. It describes in detail the installation of a 42" water line; contains specific information regarding pipe joints, field organization, laying pipe, tests, back-filling, etc. Sent free by S. R. Dresser Manufacturing Company, Bradford, Pa.

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Gate Valves and Hydrants

390. An 84-page catalog gives full design data, information about and illustrations of the complete line of Darling Gate Valves and Hydrants. Write for one to Darling Valve and Mfg. Co., Williamsport, Pa.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Large Cast Iron

408. Handy cast iron pipe and fittings catalog contains A.W.W.A. and A.G.I. standard specifications for a wide variety of cast iron pipe specialties, both bell and spigot and flanged; also dimensions Lynchburg Foundry Co., Lynchburg, Va.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints

412. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound

414. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Protective Pipe Coating

422. Coal-tar Pitch Enamels for exterior and interior linings for steel water lines; highly resistant to water absorption, soil acids and alkalis. Technical specifications for materials and their application will be sent on request. The Barrett Company, 40 Rector St., New York, N. Y.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

425. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straight-line Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

435. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sewage Filters, Magnetite

436. Well illustrated booklet describes the magnetite filter, and tells how it is used in the treatment of Sewage. Copy on request from Filtration Equipment Corp., 10 East 40th St., New York, N. Y.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip, Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Incineration

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment

448. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

453. How to avoid sludge and scum troubles in settling tanks explained in detail in Book No. 1542—has excellent drawings and photographs, also specifications. Most important are the carefully prepared capacity tables. Link-Belt Co., 307 N. Michigan Ave., Chicago, Illinois.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Valve Box Tops

475. "Cut the Cost, but Not the Pavement," is the theme of a new bulletin on Rite-Hite Valve Box Tops. Gives directions for forming new tops on valve boxes, quickly and inexpensively without digging up the old box. Just issued by Trohn's Supplies, Inc., 205 Hoyt Ave., Mamaroneck, N. Y.

Water Works Operating Practices

490. "What Is New In Coagulation" is an excellent, new review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

Drawing Supplies

495. Perspective and Isometric paper, graph paper, tracing paper, blue print hangers, automatic (irregular) curves, adjustable curves, multi-purpose charting papers, etc. Write for illustrated bulletin. Wade Instrument Co., 2246-PW, Brooklyn Station, Cleveland, Ohio.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Painting Creosoted Wood:

This small, but excellent, booklet gives specific directions for painting creosoted pine poles and posts. There appears to be two generally satisfactory methods, one using aluminum paint and the other aluminum foil. These are described fully. Booklet sent on request to Wood Preserving Corp., Koppers Bldg., Pittsburgh, Pa.

Surface Consolidation and Dustless Maintenance:

This is a good text, in simple words, on building soil roads with calcium chloride. Good pictures illustrate each step in construction. Covers also maintenance, resurfacing and spot treatment. Ask for Bulletin 33, Calcium Chloride Assn., Detroit, Mich.

Dirt-Moving:

R. G. LeTourneau, Inc., Peoria, Ill., has sent to us a book of about 100 pages. The first part of this is made up of LeTourneau catalogs and literature, but the final half or two-thirds ought to gladden the heart of anyone who has to move dirt. Page after page of data, direct from the job; long hauls, short hauls, sand work, canal excavation, airport construction, road work, etc. And for each job a description of the project, in brief; amount of yardage; kind of material; equipment used; output; cost per yard; yards per hour; and most every kind of essential information. We don't know whether all these data are for general distribution or not, but it only costs 3 cents to ask for it—and if you get it, count yourself lucky. Write G. R. Huffman, at the above address.

Acid-Proof Piping:

An 18-page catalog containing much information of value in constructing acid-proof pipings, drains and fixtures. Bulletin 902, U. S. Stoneware Co., 60 East 42nd St., New York, N. Y.

Consulting Chemists:

The Association of Consulting Chemists and Chemical Engineers has published a directory of the members of the association, with details of experience and of the work that each of these men is prepared to undertake. Address B. L. Oser, 50 East 41st St., New York, N. Y.

Cutting Power Cost:

This is a 12-page "case-book" of power saving costs. The subtitle says: "How 43 leading concerns and institutions in 29 different industries cut power costs for driving 19 different types of auxiliaries to an average of ½ cent per kilowatt hour." Ask for Bulletin 101, Troy Engine & Machine Co., Troy, Pa.

Swimming Pool Equipment:

A 16-page summary of equipment and accessories for swimming pools, including sterilizers, filters, underwater lights, cleaners, level controls, recirculating pumps, chemical feeders, ladders, diving boards, safety equipment, foot baths, and many other items needed in a complete pool. Sent on request to Everson Mfg. Co., 214 West Huron St., Chicago.

Booklets:

Elevators and Conveyors: Stephens-Adamson Mfg. Co., Aurora, Ill., catalog 47, 124 pages. Describes a complete line of belt conveyors, carriers, trippers, and bucket elevators for handling bulk materials.

Stone Crushers: Universal Crusher Co., Cedar Rapids, Iowa. Bulletin 100, covering jaw crushers; Bulletin 200, roller bearing jaw crushers; Bulletin 300, roll crushers; and Folder 19 covering portable plants.

Pumps, Lighting Units, Etc.: Homelite Corp., 178 Riverdale Ave., Port Chester, N. Y.; 4 pages. Describes portable pumps, blowers, compressors and floodlighting units.

Dusts: Mine Safety Appliances Co., Pittsburgh, Pa. 16-page booklet "Pertinent Questions and Answers Concerning Dusts."

Diesel Tractors: Caterpillar Tractor Co., Peoria, Ill. 24 pages. Deals with the adoption of diesel power by the various state highway departments. Form 4379.

Vitrified Paving Brick: National Paving Brick Assn., Washington, D. C. Folder gives excellent resume of the many admirable features of brick pavements, including long life and low maintenance.

Snow Plow and Mower: Gravely Motor Plow and Cultivator Co., Dunbar, West Va. Folder describing power driven sickle and mower which can be detached and, with interchangeable plow, used for plowing city sidewalks.

Sewage Pump: Yeomans Brothers Co., Chicago, Ill. Bulletin 6220; 4 pages. Describes Type HNC horizontal nonclog pump.

Hoists and Dump Bodies: Gar Wood Industries, Detroit, Mich. Bulletin 2 describes and illustrates heavy duty cam and roller hoists; Bulletin 3 deals with heavy-duty dump bodies.

Treedozers: R. G. LeTourneau, Inc., Peoria, Ill. 4-page folder describing a unit especially designed for clearing mesquite brush, shallow rooted trees, etc.

Bituminous Pressure Distributor: Littleford Bros., Cincinnati, O. 6 pages. Bulletin M-17 describes in detail the many features of the TS Model distributor.

Vibrating Screens: Iowa Mfg. Co., Cedar Rapids, Ia., 6 pages. Describes and illustrates the Cedar Rapids Symons Vibrating Screen.

Index to advertisers appears on page 58